
ARMY FIELD MANUAL VOLUME 2 OPERATIONS IN SPECIFIC ENVIRONMENTS

PART 3

DESERT OPERATIONS

This publication replaces
AC 71346 (Pt 3) *Desert*

1998

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"The desert ... with its agoraphobic vastness, and emptiness and sameness; an area as naked and overwhelming as a bare stage to a green actor".¹

"Many countries have their hot winds; the *khamseen* of Egypt, the *sherqiya* of Palestine, the *harmattan* of West Africa. Add all these together and blow them with sand to taste, northwards out of the gates of Hell and you may begin to know what the *ghibli* is like at Kufra in the summer".²

"Immense clouds, of reddish dust obscured all visibility and forced the car's speed down to a crawl. Often the wind was so strong that it was impossible to drive along the Via Balbo. Sand streamed down the windscreen like water. We gasped in breath painfully through handkerchiefs held over our faces, and sweat poured off our bodies in the unbearable heat. So this was the *Ghibli*."³

1. Correlli Barnett, *The Desert Generals* William Kimber, 1960.

2. W B Kennedy Shaw, *The Long range Desert Group* Collins, 1945.

3. B H Liddell Hart, *The Rommel Papers* Collins, 1953.

PREFACE

Aim

1. The purpose of this publication is to describe the effect that desert terrain will have on the conduct of operations and to introduce commanders and staff officers to the different tactics and procedures involved in these operations.
2. The essential doctrine and principles for military operations do not change because of the altered terrain conditions and thus this publication complements AFM Vol I Part 1 *Formation Tactics* and AFM Vol 2 Part 2 *Battlegroup Tactics*. It also records those tactical factors that need greater emphasis where desert conditions affect operations.

Scope

3. *Desert Operations* is split into three Parts.
 - a. Part A deals with Combined Arms Operations, the purpose of which is to provide a guide for use by commanders, staff officers and regimental planners in units and, to some extent, at formation level when operating in desert conditions. It describes the effects that this environment will have on combat operations, the functions in combat, the employment of particular weapon systems and the tactics used by the combat arms.
 - b. Part B deals with aspects that concern the individual, how he survives, lives and operates in these regions and is designed for the young officer and NCO as a basis further instruction. It provides some tactical features about movement of troops and some basic tactical features about operating in such conditions. Part B concludes with some details about the extra individual and collective training needed for desert operations.
 - c. Part C is a historical supplement which gives an insight into how soldiers have operated in the desert during previous campaigns.
4. Nuclear and biological weapons have not been used in these environmental conditions; and although chemical weapons have been used in Northern Iraq during the 1980s, the general prospect for their use in the future is considered to be remote. Nevertheless, this assessment may change, given the growing proliferation of nuclear weapons systems and the scope for rapidly producing biological and chemical agents. Many nations already have the ability to produce chemical and biological agents and it would be wrong to discount the possible use of these weapons, or to overlook the accumulated knowledge gained about their effects on combat operations in these conditions. These points are emphasised at greater length in Chapter 9 of Part A.

5. The implications surrounding the use of technology which became more apparent in the Gulf War of 1991 have not been fully evaluated yet at formation and unit level. There are obvious advantages to be gained from the coordinated use of such devices as Remote Ground Sensors (RGS), Thermal Imagery (TI) and Night Vision Goggles (NVG). More significantly, the use of attack helicopters and the greater use of support helicopters in desert terrain is subject to dynamic development. These could have a significant effect on the tactics employed by a commander and may well speed up the overall tempo of operations.
6. Every effort has been made to avoid repeating tactical details discussed in other publications; however some repetition is necessary for clarity and to provide overall coherence within this Publication.
7. In summary it is worth noting that the British Army has never had specialist desert trained units in its peace time organisation, but in many campaigns of recent times, troops and have had to acquire and use these particular skills and tactical ploys to counter the enemy. The side that best adapts and uses the environmental factors to advantage will be successful. Knowledge, preparation and training are, as always, the pre-requisites for success. As one senior British general commented after the Second World War "the British Army inevitably seems to fight uphill and at the junction point of three or more maps"; he could have added ... and probably in the desert.

Acknowledgements

8. Acknowledgements are due to those who provided text, information, comment, and the original articles in the various Parts of this Publication as follows:
 - a. The photographs in Chapter 1 of Part A were loaned from SSgt Gray 42 Engineer Survey Group RE.
 - b. The article "Re-examining the Jock Columns" by Mr Bruce Davey in Part C was extracted from the Combined Arms Journal of the Australian Army Issue No 1/98 with the permission of the editor, Colonel V H Williams and the agreement of the author.
 - c. All the remaining articles in Part C were taken from the previous publication AC 71346 (Pt 3) *Desert*.

DESERT OPERATIONS

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DESERT OPERATIONS

PART A COMBINED ARMS OPERATIONS

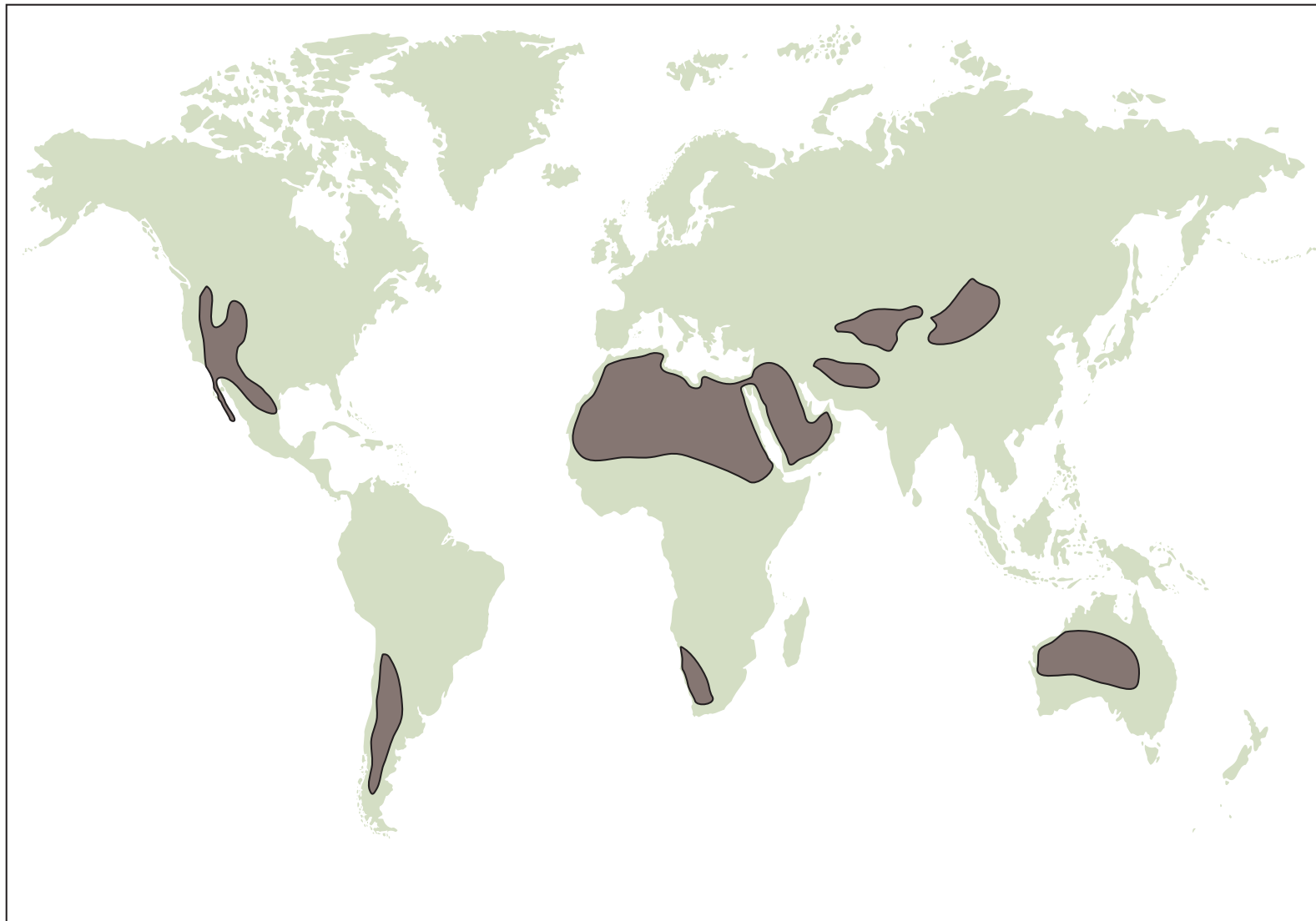


Figure 1-A Desert Areas of the World

CHAPTER I

THE ENVIRONMENT

SECTION 1 - THE MILITARY SIGNIFICANCE OF DESERTS

Background

1. Most of the world's deserts lie along the sub-tropical regions on either side of the equatorial belt where the rainfall is under 250 mm (9.84 ins) a year (see map in Figure 1-1). Over most of the North African and Arabian deserts it is less than 150 mm (5.9 ins) and only 30 mm (1.2 ins) near Cairo. Although inhospitable tribes people live on their margins and in oases, moving with their camels and goats to exploit whatever water and vegetation there is. A wide range of animals, reptiles and insects have adapted themselves to eke out a meagre existence. The map also shows the neighbouring steppe country because its open terrain has many of the characteristics of desert from the point of view of military operations, particularly in the dry season.
2. Whereas in the past deserts were seen primarily as obstacles to invasion and states were content to shield behind them, the discovery and exploitation of minerals, oil and gas have obliged governments to secure their assets against potential threats from hostile and predatory neighbours. Militarily, the control of a desert area may be as important as using it as a means of defence or of getting at an objective on the far side.¹ While deserts provided serious military obstacles to armies in the days of cavalry and animal transport, the advent of the internal combustion engine made it less difficult, although by no means easy, to fight in and to cross them.

The Setting

3. The desert is a harsh environment, punishing to both men and machines. In order to survive, to fight and to win, the limitations imposed by terrain and climate have to be understood and provided for. Equipment and tactics need to be modified and adapted to account for a dusty and rugged landscape where the temperature may range from torrid to freezing and visibility may reduce from thirty miles to as many feet in a few minutes.

SECTION 2 - TERRAIN

Variety

4. Deserts provide an infinite variety of terrain. The basic land forms are similar to those in other parts of the world but the top soil has disappeared through a combination of

1. Control of the Khuzestan and Kirkuk oilfields was amongst the objectives of the protagonists in the Iran-Iraq War. In the Second World War the Egyptian and Libyan Deserts provided, on the one hand, a defence in depth for the Nile Delta and the Suez Canal for the Commonwealth forces and, on the other, an obstacle to be traversed to evict the Axis forces from their bases in Tripoli and Tunisia. Sinai has been used as a shield by both Egypt and Israel in 1967 and 1973.

lack of water, heat and wind erosion to give deserts their characteristic stark appearance. The bedrock may be covered by a layer of flat sand or gravel or may have been exposed by erosion. Other familiar features are sand dunes and sand seas, escarpments and gebels, wadis and depressions. The military implications of these features are examined below.

Sand

5. A thin layer of hard sand on a shallow, even rock base provides good, fast going, motorable in any direction up to 60 mph. Tracks made by wheeled vehicles or tanks last indefinitely but as time passes they lose their sharpness of definition and collect a sand infilling. Following a period of heavy rain an extensively used track sets like concrete and remains for decades. An experienced desert soldier can judge the age of a track roughly, which may provide useful intelligence in those parts of the desert which are not laced with them.²



6. A thick layer of sand, about one metre deep, on a rock base makes for bad going with the inconvenience of constant towing or digging out. Sand blown into soft hillocks against bushes is also bad going and should be avoided.
7. Sand sea, passable on a winter's morning before the sun burns off the hard crust formed by the dew is difficult to cross later in the day or in the hot season.³
8. Sand dunes occur in two varieties:

2. Contrary to popular belief, sand seas are not the main features of deserts, only 30% in Arabia, 10% in the Sahara and 2% in the deserts of North America.

- a. Jumbled dunes of deep sand, virtually impassable to wheels and to all but light, wide-tracked vehicles.
- b. Razor backed dunes blown into a series of waves at right angles to the prevailing wind with a shallow gradient leading up the windward side to a knife-edged crest and an abrupt descent on the leeward side. Vehicle movement is possible with the grain of the country along the valley bottoms between the dunes but difficult across the grain.

Gravel

9. A flat gravel surface provides excellent going in all directions. The main problem in flat featureless desert, whether gravel or sandy, is concealment. There is usually, but not always, some dead ground to provide cover from direct observation from a ground OP. Concealment from the air is virtually impossible. Digging gives protection but can be conspicuous.



Rock

10. Bare rock is generally rough and sometimes deeply pitted. Ledges make driving difficult, cut tyres, damage vehicles and tear boots. Digging in is a slow and laborious business requiring drills and explosives.
11. Sangars can be built quickly from loose rocks but because they are visible and vulnerable to any weapon larger than small arms, they are only suitable for defence against a lightly armed enemy. To reduce the incidence of eye wounds, sangar walls need to be topped with sandbags.



Mountains and Escarpments

12. Mountains (gebel) and escarpments offer major obstacles to movement, sometimes for many miles. The gaps through them have even greater significance than gaps through sand dunes because the ground is much firmer and they are difficult to bypass. On the side facing the prevailing wind large sand dunes accumulate while alluvial fans spread out from gorges on the leeward side. The former can offer major impediments to movement while the latter are motorable, except after heavy rain, if they are not too deep.
13. Escarpments provide the good observation associated with hills anywhere and locations for radar to detect air and ground movement deep inside hostile territory. Even quite minor features give their possessors commanding views for many kilometers. The construction of defences in rock suffers the disadvantages mentioned in paragraphs 10 and 11 above, although bushes and scrub often provide some sparse but useful cover. The emplacement and concealment of mines is easy in sandy wadis but difficult on rocky slopes. Plateaux lend themselves to reverse slope positions but defences are difficult to site and conceal on razor-backed ridges.
14. Low escarpments offer a good defensive position facing in either direction. The defender holding the rim with the cliff immediately behind him can tuck his command posts and mortars in at the foot of the escarpment and carry out forward replenishment in its lee with a measure of immunity from all but high angle, indirect fire. However he has little depth to his position unless a similar, parallel escarpment runs within mutually supporting distance behind it. The defender whose escarpment faces



the enemy has the advantage of better observation and can make full use of the gentle reverse slope to site defensive positions in depth. Sometimes the prevailing wind piles up a low ridge of sand on top of the escarpment to provide useful cover. Bow window shaped escarpments turn the gentle slope into a semi-circular saucer-shaped depression offering the defender holding the outside edge of the rim an excellent concentric fire trap but, again, no depth. A defender facing the opposite way on the same kind of feature holds a strong position with refused flanks.

Wadis

15. Dried watercourses (wadis) vary from wide but barely perceptible depressions of soft sand, dotted with bushes, to deep, steep-sided ravines. The former are no serious obstacle to movement, only a nuisance because the bushes and tussocks of grass often grow on small hummocks. Combined with soft sand they make for slow going in low gear. Steep-sided wadis offer a more serious impediment to tracks and wheels because they are only passable in a few places without engineer effort. The sand in wadi beds can be mined, usually only by hand because of rocks and tussocks, to provide a useful obstacle.
16. There is often a motorable track at the bottom of a dried watercourse which may provide the only practicable route through gebel or an escarpment. Wadis provide cover from ground observation and possibilities for camouflage against visual air reconnaissance. However, if there is a wet season they are liable to sudden flash-flooding, even though the rain may fall in gebel many miles away. The consequences for the unwary may be serious, particularly at night when men can be drowned in their bivouacs.



Salt Marshes

17. Salt marsh (sebkha) is treacherous, especially near the coast or in depressions. There, wet sebkha may be impassable. Away from the coast and on higher ground where it drains better sebkha may be passable the day after rain, or even later on the same day. Tracks have little difficulty in negotiating it but wheels bog down if turned suddenly. Turns should be made gradually and vehicles should not travel in the tracks of those in front because even in good weather the thin, dry, brittle crust soon breaks up. As sebkha absorbs moisture it often darkens to provide a warning. If sebkha can be avoided it should be but there may be occasions when a risk is worth taking.

SECTION 3 - CLIMATE

Extremes of Climate

18. Because most meteorological stations are located near the coast or on high ground there is a lack of accurate records and information on desert climates. Deserts are often hotter or colder than the available statistics indicate. The highest officially recorded temperature is 58°C (136.4°F) for the Libyan and Mexican deserts and the lowest -45.55°C (-50°F) for the Gobi Desert.³

3. The highest surface temperature recorded is for the Mojave Desert, California: 94°C (201°F). Well before that temperature is reached, objects in direct sunlight are too hot to touch.

19. There is also a wide range of temperature variation between the heat of midday and early afternoon and the chill of night, for example as much as 40°C (72°F) in Sinai. Similarly, there are marked seasonal changes in temperature. In winter, the cruel blast of cold air blows down the Gulf from the north. Such marked temperature changes produce a heavy dew at night. Consequently, pullovers and warm clothing are needed after dark and gunners have to keep a constant watch on the changing meteorological data. Heavy dew causes bare metal, particularly weapon parts, to rust quickly.
20. Deserts near the southern Mediterranean shore are perhaps the most bearable. The coastal strip is cold and often wet in the winter, subject to sand storms in March and hot in the summer. A breeze usually gets up as the sun heats the surface and dies away at sunset, often to blow from the opposite direction at night. South of the meagre winter rainbelt about 180 Kilometres (100 miles) from the coast the Sahara is dry and the summers are scorching. In the Arabian Peninsula the climate along the coast is uncomfortably humid in the summer but the temperature seldom rises above 39°C (100°F). In winter, the littoral along the southern rim of the Peninsula is a pleasant 61°C (80°F). In the Gulf the winter days are sufficiently chilly for warm clothing and sometimes wet enough for waterproofs. The summers are hot and humid near the coast and inland the heat is so torrid and oppressive in the Rub al Khali (the Empty Quarter of south-eastern Arabia) that it may be wise to rest under the shade of a vehicle canopy or a hession-backed camouflage net in the middle of the day unless compelling operational necessity forces one to move or fight. Away from the coast the Iraqi desert is blisteringly hot in the summer, 50°C (122°F) or more, and cold in the winter. Frosts occur on northern Iraqi winter nights. The occasional oases, like Kufra and Siwa in the Sahara, cover quite large areas and provide some shade and a supply of water.

Wind and Sand

21. Even without a wind the tell-tale clouds of dust raised by wheels, tracks and marching troops give away movement. Wind aggravates the problem. As the day gets warmer and the wind increases the dust signatures of vehicles may drift downwind for several hundred metres. In many deserts a prevailing wind blows steadily from one point of the compass for most of the year, switching to another for the remaining months, to provide the soldier with a rough and ready sense of direction. The equinoctial gales raise huge sandstorms which rise to several thousand feet and may last for several days at a time. In winter and spring the temperature rises sharply in the hot winds which blow sand in from the Sahara, while gales and sandstorms in the winter can be bitterly cold. Muzzle blast, shell bursts and the movement of tracks and wheels raise thick dust clouds which can reduce visibility to a few yards. Orientation and direction keeping become difficult and unexpected contacts with the enemy can take place with little or no warning. The effect of dust and sand on surveillance aids is discussed in Chapter 3.
22. Sandstorms are liable to blow up suddenly and stop just as quickly, interfering with the timings of military plans. Sand gets into everything and in a thick sandstorm movement is slow and difficult. Satellite navigation systems make it possible to keep direction and locate one's position accurately in the worst of conditions. The limiting

factors are the damage inflicted by masses of blown sand on the moving parts of machinery and the lack of visibility. It is only safe to drive when the ground to be covered is known to be good going. In a thick sandstorm one should remain under cover. Shirts must be worn, sleeves pulled down, the head, neck and eyes covered up. Sand goggles are invaluable but blown sand still gets inside. If it is absolutely necessary to leave cover, even for a few yards, one should keep in touch with a vehicle or trench by letting out a length of string or cable to avoid getting lost.

23. The wind can be as trying as the heat, lashing face, arms and exposed skin with a stinging cloud of fine blown sand. Sand gets into eyes, nose, mouth, throat, lungs, ears, hair and reaches every part of the body. Even speaking and listening can be an effort. Hats and camouflage veils can be blown away, maps are ripped off their boards.



24. Continual exposure to blown sand is exhausting and tempers become frayed. Operations come to an abrupt halt in a sandstorm and the side whose desert training enables it to get back into action quicker when it subsides has the tactical edge for a few vital minutes. Even when there is not enough blown sand to impede movement, strong winds drown out most sounds and the first indication of a hostile contact may be a casualty. Wind and blown sand hide small arms weapon signatures and make location of the enemy difficult and degrade the performance of lasers and thermal imagers. Such conditions hinder the observation of all types of fire.
25. Drivers have to observe 'dust discipline', moving slowly and carefully in exposed forward areas where clouds of sand thrown up by reckless driving may give away tactical dispositions and draw enemy fire. Even when air supremacy is available, vehicles should move well apart to avoid collisions in the clouds of dust thrown up by wheels and tracks. During controlled moves traffic lanes should be separated by a safe distance whenever possible. In rear areas dust can be a serious nuisance in

headquarters, administrative echelons, combat service support (CSS) installations and rest areas. Tracks may be oiled or surfaced by mix-in-place techniques to reduce the problem, as well as to provide a better surface for heavy vehicles. Where this is not possible traffic patterns may be established to direct vehicles downwind of camps and bivouacs and into car parks to control the annoyance. Oiled tracks become slippery after rain. Special routes have to be set aside and marked for tracked vehicles to avoid damage to roads and tracks used by wheels. Crossing places between track and wheel routes must be properly engineered.

Light

26. Visibility is excellent in the early morning and good in the evening looking down-sun. Conversely, visibility is very bad looking up-sun. There is as distinct a tactical advantage in manoeuvring to engage the enemy down-sun in the desert as there was in seeking the weather gauge at sea in the days of sail. As the ground heats up a shimmer develops in the middle of the morning, which turns into a heat haze at midday and a mirage in the afternoon. Objects appear to float about, separate and merge together so that at 1,000 metres vehicles and equipment become unrecognizable. For surveillance and target acquisition aids, as well as the unaided eye, high ground giving observation above the heat haze is at a premium. Even a small hillock just a few metres above the desert floor is sufficient. Because thermal imagery gives a clear picture through the heat shimmer it provides better observation and accuracy of engagement than any other system. There is one exception to the good quality of vision in the early morning. Near the coast a heavy mist may form overnight. However, the rising sun usually clears it within half an hour or so.



27. The foreshortening of shadows in the middle of the day reduces the sense of perspective, adding to the recognition problem. It also makes range estimation with the eye¹ difficult, especially when there are no landmarks. The margin of error is many times greater than in European terrain where horizons are shorter and there are plenty of objects like houses and pylons to lend a sense of magnitude and scale. For example, looking down-sun an object can appear to be only half the distance away than it really is, hence the usefulness of laser range-finders and aim-off fed into optical sights by computer. Haze and changes of light looking towards or away from the sun add still further to the problem of judging distance. Light reflected from glass or talc can be seen for 40 miles and will cut through haze to give away a position which would otherwise be hidden from the enemy.
28. Moisture on the ground is reflected by the clouds. Normally the reflection is sand coloured but within 20 or 30 miles of the sea the clouds acquire a bluish sheen. If a soldier is not too sure where he is this phenomenon can be reassuring.
29. Oil wells and installations set on fire by a withdrawing enemy may produce thick clouds of black smoke which drift for miles. By day, the smoke dims or even hides the sun. With reduced visibility and no shadows to give a sense of perspective, judging distance and identifying the enemy becomes more difficult. By night, the glare from the fires may help movement but enable troops in position to spot a moving enemy first. Close air support becomes harder to control and because ground to air recognition is more difficult there is a greater risk of attacks on friendly troops.

Night

30. A full moon almost turns night into day. One can see for miles and even read a map. A quarter moon gives sufficient light to drive without aids. With no moon or just a thin crescent, the night is pitch black, especially in deserts near the coast where cloud cover at certain times of the year leaves no ambient light, let alone stars for navigational use should other aids fail. However, movement on the darkest of nights in all but the worst going is now possible with a satellite navigation system and thermal imagery. Image intensification needs some ambient light. Even with aids, movement across very rocky and difficult ground is still slow and frustrating. On the darkest of nights, progress on foot is possible but slow, and, in the absence of a satellite navigation aid, with a well trained navigation party, the calculation of bearing and distance can be very accurate. In very bad, rocky going it may even be quicker to march.
31. The phases of the moon are an important factor in planning vehicle movement at night. When the moon is in its first quarter there is sufficient light until midnight. With a full moon it is light all night and when the moon is in its last quarter driving is possible in the second half of the night. Visibility is so good in moonlight that with just a quarter moon vehicle dust can be seen for miles, so that while movement is possible it is hard to conceal. Night observation, driving and sighting systems have eroded the cover darkness provided for rest and maintenance (as in the Second World War). One consequence is that movement may only pass undetected from the ground if covered by terrain features. Another is that now the 24 hour a day battle has become a reality commanders and their soldiers will suffer from exhaustion much sooner than before.

Operation *Desert Storm* was concluded in four days, even so, everyone who took part in it was very tired at the time of the ceasefire. In future, commanders will have to plan to deal with the fatigue problem, perhaps by organizing individual reliefs at the lower end of the scale and phasing operations to allow fresh formations or units to take over from exhausted ones at the upper end of the scale. RPVs and satellites make surprise moves difficult to achieve.

32. Noise carries great distances on a quiet night, adding still further to the difficulty of hiding a secret move to gain surprise. Listening posts are an essential element of any protective screen. On the other hand a wind can drown the sound of engines and tracks, and the possibilities for deception are considerable.

Rain and Thunderstorms

33. Rainfall in the desert varies from one day in the year to intermittent showers throughout the winter. Usually, far too much rain falls far too quickly to organize collection on a systematic basis. The water soon soaks into the ground to cover the surface with a beautiful but brief sheen or runs in torrents down the wadis. Cisterns, built by local people or left over from vanished civilizations, are to be found where there is sufficient rainfall and while some wells and oases are replenished by local winter showers most rely on sub-surface seepage and artesian systems filled from sources hundreds of miles away and centuries ago.
34. While rain may bind a sandy surface to provide transient good going, like a beach when the tide ebbs, it may turn loam into an impassable morass. Rainstorms can be very local, immobilising only one side to allow the other freedom of manoeuvre to gain a tactical advantage. When a storm is approaching vehicles should be moved on to rock or high ground if the tactical situation permits. Heavy rain is often accompanied by severe thunderstorms. Lightning strike is a serious hazard in the open desert and precautions to protect men and equipment are necessary.

Vegetation



35. Apart from the bushes and tussocks of grass growing in wadis, already mentioned in connection with going (see paragraph 15 above), trees such as acacias also grow in wadis, particularly near gebel, to provide local landmarks and reference points. High mountains in the middle of a desert may attract sufficient rain to support a carefully nurtured agricultural system, such as on top of the Gebel Akhdar in Oman.
36. Some plants, like the desert gourd, have vines which grow over the ground for up to 4.5 metres (15 feet). Others have wide lateral root systems just below the surface to take advantage of rain and dew, while still others grow deep roots to tap sub-surface water.
37. Palm trees usually indicate water within a metre of the surface, salt grass within two metres, cottonwood and willows up to four metres. Apart from indicating the presence of water some plants are edible.

CHAPTER 2

OPERATIONAL FACTORS IN DESERT OPERATIONS

SECTION 1 - THE POTENTIAL THREAT

Background

1. History and experience shows that desert regions in the past have been crossed and recrossed by armies looking for a decisive military result elsewhere to end the campaign. In more recent times these regions have generally formed a geographical barrier between two or more states, and it is this that tends to indicate that the regions may well be the first areas where combat starts in any new campaign.¹
2. The vast scales and remoteness involved in the world's desert regions precludes a precise definition of any generic enemy. However, some outline definition is necessary as an essential background against which operational planning and tactical procedures can be set and from which training programmes can subsequently be derived.
3. Since 1989 the threat of a Soviet style invasion has virtually disappeared, but it is entirely feasible to note that this large and potentially serious threat has been replaced by a more aggressive form of nationalism or self determination based on other cultural values and that fresh tensions could appear almost anywhere in the world including desert regions. Requests for assistance to the UN or NATO by beleaguered nation states in vulnerable areas could result in some form of military deployment. New technology and scientific improvement has also improved living conditions to such an extent that it is now possible to take refuge and operate in and from desert regions on a near permanent basis. This form of activity has already occurred in Morocco and Algeria.

Planning Assumptions

4. Overt armed aggression by the regular forces of one or more nations against another in one of the many desert regions of the world is the most likely potential threat that could develop. This aggression could take many forms, but at worst, it could be an all out war in which these geographically hostile regions are used as the battleground for obtaining a decisive result. It is this assumption that forms the backdrop to the subsequent Chapters of this publication.

Enemy Characteristics

5. The various locations of the world's desert regions do not preclude a potential enemy in the region from having large and generally well equipped armed forces, but more significantly, having access to modern weapons systems and military resources. It would thus be wise to assume that any future enemy is likely to be adequately

1. The Gulf Wars of 1980-86 and 1990-91.

trained and equipped and could sustain land and air operations in these regions for some time

6. Beyond this general categorisation, it is well known that resistance fighters, guerillas, and insurgents have used desert terrain to build their organisation and harass the state or occupation forces. These actions could take place within a given theatre of operations for general war.

Enemy Aims

7. It should be assumed that an enemy has gained the ability and experience to fight in desert regions. Similarly, it has to be assumed that the enemy has the ability to conduct operations on a larger and more coordinated scale at up to formation level, and that he would aim to dominate and control areas and to defeat an adversary as quickly as possible while relying on a firm base to sustain operations.
8. An enemy could also take advantage of the same operational principles that we adopt and would, no doubt, utilise the same sort of military resources to a similar level of sophistication. However, the constraints and limitations that affect fighting in desert regions will apply equally to the enemy and this, if used to advantage, could contribute to his defeat if the operational initiative can be obtained.

SECTION 2 - JOINT AND COMBINED OPERATIONS

Background

9. Following a government instructions to deploy a force for operations in desert areas, decisions would be taken within the MOD on the type and size of force to be sent and on its subsequent deployment. These are beyond the scope of this publication.
10. It is unlikely that British forces will operate alone in any future operations in such an environment; the prospect of operating in conjunction with a multinational Alliance, or Coalition is much more likely. AJP1(A), JWPO-10 and ADP Vol I *Operations* all provide further details on joint and allied cooperation.

Coalitions/Alliances

11. Whether any military grouping would come under UN, NATO, Commonwealth or Coalition auspices remains to be seen, but whatever the circumstances, there would need to be integrated command and control arrangements.
12. It is also likely that the British Authorities would nominate a self contained formation for commitment to such operations, although it is perfectly feasible to nominate only a formation headquarters, or even individual trained staff officers, observers and specialist to assist other nations or governments.
13. Whatever the British contribution, an awareness of the main characteristics of working within a group of other military partners is important. These are set out in Chapter 6 of ADP *Operations* and will require careful study.

Joint/Combined Operations

14. Any British force committed to operations in a desert region will invariably be joint at the appropriate level of command and will be working to a single joint force commander.
15. In the absence of Alliance (eg: NATO) procedures being used in the operational area then UK Joint Operating Procedures should be utilised until other operating arrangements are agreed.

SECTION 3 - COMMAND, CONTROL AND COMMUNICATIONS

Command

16. An army trained and equipped for operations in temperate climates requires both specialist training and additional equipment for deployment to a desert region. This essential prior preparation may engender apprehension and uncertainty amongst soldiers who have never experienced these conditions and environment and could place additional pressures on commanders at all levels.
17. The use of mission command and main effort² will be just as important as tools of command in desert conditions as elsewhere. The commander who restricts flexibility by issuing over-detailed orders is likely to restrain his subordinates from using their initiative and may miss the opportunities that changes in the general situation and the weather might present. By designating a main effort a commander will be indicating where his priorities lie, thus allowing subordinates to act in accordance with the mission and in the absence of new orders.³
18. The military emphasis in deserts is likely to be on formation operations and conducted over extended distances and under difficult communication conditions. There will be a danger that units may be cut off in these situations. A rigid style of command will not thrive in such an environment and subordinates should be encouraged to act in the absence of orders.

Command and Control (C2)

19. **Organisation.** The organisation of C2 in desert operations will depend upon the type of operation envisaged and the extent to which local conditions affect normal procedures. Mobility will be one of the main command tactics and it may be necessary to reduce the size of headquarters in order that mobility can be maintained.

2. See AFM *Formation Tactics*, for details of 'main effort'.

3. Note that main effort is not merely the tool of operational commanders. In desert operations, particularly where resources are limited and lines of communication lengthy, the use of main effort in Combat Service Support planning will also be crucial.

20. **Relationships.** The command and control relationships between units and formations do not change in desert operations. The states of command and fire support control terms are described in Chapter 2 of *Formation Tactics*. Control of operations, control of fire, airspace control and control of the EM spectrum in the desert all conform with normal operational conditions.

Organization, Siting, Communications Planning and Movement

21. **Main Headquarters.** Because desert operations are so mobile it is necessary to have two identical main headquarters for an armoured formation. Each has its own resident staff of watchkeepers, signallers, drivers, administrators and its own commander. Rather than calling them 'main' and 'alternate', giving the impression that the latter is only a stand-in, they may be designated ALPHA and BRAVO. Whichever complex is stationary, open and manned by the primary staff is known as 'main', while the other is moving to its next location. The groups of vehicles making up the functional clusters should be kept as small as possible, each should be surrounded by a 2 to 3 metre high sand berm for protection when static. If the commander has a separate tactical headquarters it will normally rejoin at night. In the absence of sufficient armoured vehicles to form a 'hard' rover group the formation commander and his headquarters may control the battle from one of the two halves of main deployed specially for the purpose.
22. **Rear Headquarters.** The rear headquarters will be located with the support group. Ideally, it should be armoured and capable of being split into two like main. If resources will not run to this, sufficient communications should be allotted to provide rear with a step-up, leapfrog facility. To control the miscellaneous units in the support group a wheeled headquarters will suffice
23. **Visual and Electronic Pattern.** In addition, a formation will usually have at least two communication centres. Consequently, headquarters tend to develop a visual and electronic pattern which it is important to disguise with good camouflage and deception. Remoted communication centres help hide the exact location of the headquarters itself. If the campaign lasts long enough the creation of dummy headquarters and radio emissions may be useful both for survivability and for deception purposes.⁴
24. **Artillery.** It may be expedient to divide the artillery into three functional groups:
- a. A direct support group of field regiments to support the formation contact battles.
 - b. A general support/reconnaissance/strike group to integrate long range guns, MLRS, locating devices, medium reconnaissance, aviation and air to execute the depth battle.
 - c. An air defence group.

4. In the Gulf War of 1991, while 1 (BR) Armoured Division moved up from its concentration area on the east coast of Saudi Arabia towards its new assembly area, signals traffic recorded on previous exercises was broadcast from the old location to deceive the Iraqis.

All artillery groups come under the senior artillery commander. The concept is referred to again in connection with armoured reconnaissance, artillery, target acquisition and fire support.

Siting

25. **Dispersion.** Even in the flattest of deserts there are wide depressions and wadi beds, with barely noticeable banks, but which collect sufficient moisture to grow bushes, scrub and patches of coarse grass over a very wide area. In the absence of deep sided wadis, broken, hilly or 'moonscape' country, gebel and escarpments, scrub may provide the best opportunities for camouflage and concealment but at the expense of dispersion. To some extent this can be offset by computer technology and repeat information displays round the dispersed branches. However, the operations and intelligence staffs should be kept together in the centre of the ALPHA and BRAVO headquarters layouts. A conscious effort has to be made to keep all branches of the staff in contact and fully informed of a developing situation.
26. **Survivability.** As survivability is so important the inconveniences of dispersion has to be accepted in open desert. Protection and concealment can be obtained by digging in tracked vehicles below ground level. Using engineer equipment to raise berms of sand round groups of vehicles helps to hide them from enemy ground observation and provides protection from the splinters of enemy artillery fire.
27. **Security.** Although a headquarters has to be able to protect itself from the minor threats of low level infiltration it should be sited within the defence pattern of its subordinate formations and units to avoid being overrun or having to move at a crucial point of a battle. Even so, distances and dispersion are so great in the desert that a far more substantial force is needed to protect a formation headquarters than elsewhere. It should include reconnaissance, anti-tank and mortar elements in addition to the normal rifle and GPMG component. A protection group should also be covered by the envelope of an existing air defence system. Apart from terrain and protection, a key feature in the siting of a headquarters is ease of communication.

Communications Planning

28. **Expert Advice.** Desert battles are often fought at speed over a wide area involving bewildering changes in the situation. Control, and the passage of information on which it depends, are of vital importance. Good communications, capable of meeting every eventuality, have to be guaranteed and this can only be achieved by careful planning. The operations staff will be guided by their communications advisers in selecting sites and alternative positions for formation and unit headquarters. See further details of communications lessons learned in a recent major desert exercise during 2001 in Annex A to this Chapter.
29. **Grouping.** In an advance, rebroadcast stations have to start off with and keep well up with the formations or units they are to support if they are to maintain contact with their headquarters. Trunk nodes have to be grouped with other elements for movement, security and feeding. The communications reserve should also be deployed as far forward as possible to permit timely deployment to meet changes in the tactical situation. Communications locations need to be marked on the operations staff's situation maps to avoid accidental engagement by friendly fire.

30. **Reconnaissance and Siting.** Depending on the type of radio equipment used, line of sight communication, involving intervisibility between two high points, remoted from the headquarters concerned, may be important. Because desert cartography may not be entirely reliable it will be necessary to carry out a reconnaissance to confirm that line of sight communication is possible between the two points which, from the map, appear to be intervisible. Rebroadcast stations will be needed to overcome nap-of-the earth screening problems.
31. **Restrictions on the Use of the Frequency Spectrum.** All combat net radio frequencies are affected to some extent by extremes of temperature. The problems with high frequency communications are that the sky wave is more affected by variations in the atmosphere, and the ground wave is absorbed quicker by sand than by the soil of temperate climates. Very high frequencies are prone to thermal ducting, a phenomenon which occurs when air temperature inversions cause air ducts between layers of the atmosphere relatively close to the ground. VHF signals may be transmitted unpredictably at different times of the day over immense distances to be the cause of long range interference and chance interceptions. Only a very close and careful management of frequencies will overcome the problem. A more generous allocation of frequencies will be needed and this, in turn, points to the necessity of having one central authority for the allocation of frequencies in any multinational force. To provide all informed communications over the wide area occupied by a formation in the desert the near vertical incidence high frequency skywave technique, employing suitable horizontal antennas, should be used. 'Skip distances' are greater and frequencies have to be changed at night. To overcome these limitations long ground spikes are essential and antennae should be elevated whenever possible, even during short halts.
32. **Emission and Frequency Control.** Equally, the need to control or mask electronic and radio emissions has a bearing on the siting of a headquarters. The emission control policy should be decided by the threat and should be looked upon as a vital element of any deception plan. In some desert, areas will have a good communication infrastructure of their own, supplemented by commercial networks, such as those provided by the oil industry. On the other hand, in a desert where there are few civil telecommunications, there is a requirement for extra radios, relay systems and frequencies, so that frequency control assumes a greater significance.
33. **Land Lines.** Vast amounts of land line are needed to provide communications within headquarters, units and logistic installations. Whenever practicable cables should be buried. Whether buried or on poles, a well established vehicle traffic pattern is needed to preserve both communications and vehicles.
34. **Trunk Communications.** Multichannel radio and satellites offer the most economical means of providing trunk communications in static conditions. In mobile operations the trunk communication system may be unable to keep up with the pace of the battle and reliance may have to be placed on vehicle antennae. There is a limit to which a trunk system can be stretched. A satellite system is invaluable for filling the gap between the various groups within the formation. Additional single channel radio access (SCRA) tracked vehicles are required.

35. **Movement.** In mobile desert operations the movement of headquarters is likely to be far more frequent than in other environments. Two methods of changing position may be used:
- a. If a headquarters has main and rear elements, in addition to its tactical headquarters, each may be split into two groups so that one is always *in situ* and open. In the event of a nuclear threat this arrangement also provides a measure of survivability.
 - b. A headquarters with tactical, main and step-up elements only may not be able to follow the same procedure. The alternative method of operating is for the commander to keep his tactical headquarters well forward with main no more than a tactical bound behind. The latter will catch up with the former whenever it halts long enough for it to do so. The step-up may be used to range well forward, relaying messages between main and forward units when necessary. In static conditions it may be necessary to move a headquarters periodically in the interests of security and survivability.

SECTION 4 - THE CONDUCT OF OPERATIONS

Concepts

36. This publication deals primarily with how to operate tactically in desert conditions wherever they may occur. The land areas are normally vast and generally inhabited by very few people. As with other military operations there is clear advantage in capturing or holding areas of vital ground, such as passes over mountains or high ground where movement is canalised, perhaps because of 'going' restrictions.
37. There is, however, every reason to prevent the enemy from making use of the terrain features and weather conditions to sustain his operations; this can be achieved by seeking to dominate and control critical terrain and the airspace above it in such a way that the enemy cannot operate there without disruption to his plans.
38. When this is achieved the ground can be utilised to canalise or restrict enemy movement which then can lead to more aggressive activity to destroy the enemy's will and capability to fight.
39. For a commander the first operational task could be to regain the tactical initiative from the enemy by establishing control and domination over the designated area of operations prior to making any further plans to defeat the enemy. Once this has been established operations on a larger and more coordinated scale can then begin.
40. Experience from history and previous campaigns in desert terrain indicates that, at an operational level, the use of bold thrusts that move directly to areas of vital interest while making use of deception to mask the obvious moves of reserves could provide the basis for military success. The terrain, weather conditions and seasonal changes could have an overwhelming effect on the chances of success or failure and certainly alter the pace and tempo of operations. A commander who ignores the opportunities afforded by the terrain and changes in weather conditions will not succeed.

41. Similarly a commander will need to arrange his forces in such a manner to make best use of the resources available. The grouping and regrouping of forces to take account of the task in hand will offer the greater potential for success. The acquisition of the attack helicopter and the combat groupings that can be generated from this weapons platform have to be exploited to the fullest extent.
42. There will undoubtedly be constraints and limitations that affect a commander's ability to conduct operations in desert regions but these do not alter the approach to operations described in Chapter 2 of ADP Vol 1 *Operations* and in more detail in AFM Vol 1 Pt 1 *Formation Tactics*.

Attacking an Enemy's Cohesion

43. In the desert attacking and fragmenting an enemy's cohesion and rendering his resistance ineffective is deemed to be potentially more rewarding than other tactics, at least initially.
44. Breaking cohesion can be achieved in many ways and a commander will need to be flexible in utilising any number of factors to tighten the noose until it becomes a stranglehold. The main techniques that can be applied are:
 - a. *Firepower*. The selective application of firepower to attack vital bases, communication sites, command posts and logistic installations are probably those targets which have the greatest worth in desert terrain.
 - b. *Tempo*. The rate of activity in relation to the enemy is the key factor. The terrain will inevitably speed the pace of battle for all sides in comparison with operations elsewhere, but if a commander can make decisions quickly and control the pace of operations at a faster rate than the enemy he will quickly gain the operational initiative.
 - c. *Simultaneous Operations*. In conjunction with tempo this technique seeks to overload the enemy commander so much that he is forced to divert time and resources away from his main operational aims.
 - d. *Surprise*. There are many possibilities for achieving surprise both in timing and location and these should be applied at every suitable opportunity across all levels of command.
45. Liaison officers at all levels of command are essential. They should be suitably chosen and briefed, and capable of moving rapidly around the operational area (probably by helicopter). Given suitable radio links, liaison officers can back up and endorse the commanders's control of operations, as well as confirming any changes in tactical planning, or reporting developments as they occur. This should allow a commander to be at the place of best information during periods of activity.

Combat Identification

46. Positive identification of enemy targets is always difficult but in the desert and with extended visibility it is even more complicated. The danger of contact between friendly

forces is a permanent hazard of operations and a clear definition of boundaries, objectives and other ground locations is necessary to reduce the change of this danger.

47. Misunderstandings and accidents cause casualties, prejudice security and lower confidence. SOPs have to contain precise instructions for identification, both on the ground and in the air. Policy for the accurate location and marking of mines and traps should also be clearly defined.

SECTION 5 - THE FUNCTIONS IN COMBAT

General

48. The principles of war are the basis for the successful employment of military force in combat. The guidance of these broad principles is translated into operational concepts which are known as 'functions in combat'. The practical expression of the 'functions in combat' is combat power and physical capabilities. When guided by doctrine and with the human dimension added, the result is 'fighting power' which defines the ability to fight.
49. These 'functions in combat', their validation and their use on the battlefield are covered fully in AFM *Formation Tactics*. Additional factors which apply to a desert environment are mentioned in subsequent paragraphs.

Command

50. The sheer scale and nature of a desert environment make the achievement of good and effective command and control (C2) more difficult than elsewhere unless the aims of any military activity are very simple, clear and direct.
51. Realistic timetables and timings based on sound practical knowledge of deserts are the key to successful tactical operations. If in doubt plan for two or three times the time it takes to achieve the task elsewhere, particularly for movement by night.
52. Once operations begin, the problems of command and control in practical terms, devolve down to junior commanders very quickly. Simplicity is thus the key to planning at formation level. A commander should make his operational aim and the method of achieving it very clear - not least because it enhances control. It is important to note that good workable and well rehearsed SOPs (which include drills for lost soldiers as well as communications and medevac procedures) are essential to allow for effective devolution of command and control.
53. However, a large element of initiative and latitude has to be built-in to any plan to allow subordinate commanders the ability to overcome the changing pace of operations.

Manoeuvre

54. Manoeuvre enables friendly forces to engage and destroy the enemy. This is vital, particularly in the desert. The use of engineers to improve mobility, and equally, to

prevent the use of critical terrain by the enemy is a battle winning factor for a tactical commander.

55. Sensible planning by formation staffs taking full account of the capabilities of the soldier, his weapons systems and his level of training, will prevent over ambitious assumptions about movement (and hence manoeuvre) in desert operations. This, combined with an appropriate allocation of weapon systems, will also keep the necessary balance and cohesion in the grouping of forces during moves and also allows for unexpected contacts or delays.
56. In the desert, mobility which forms a major part in achieving manoeuvrability, is a three dimensional factor of great value. A commander who can make positive use of the ground, the air and suitable terrain to move troops and supplies will gain the tactical advantage that mobility provides. These are:
 - a. *Ground Mobility.* The speed of movement will depend entirely on the terrain. Movement up and over challenging geographical features in hot conditions is difficult and time consuming. Keeping to known tracks, ridges and higher ground is usually the easiest method of movement, but, correspondingly, it may be the most obvious route to an enemy.
 - b. *Helicopter Support.* The availability and use of helicopters for observation, reconnaissance, attack, protection and transportation significantly enhances a commanders' ability to monitor and develop military operations in desert areas. Many of these techniques have been practised elsewhere in other types of terrain and are not new, but in this environment the opportunity to profoundly affect the conduct of operations is enormous. Nevertheless their use in these areas will require particular techniques. This enhancement also provides a logistic penalty in terms of wear on rotors and turbine blades. This has to be tempered because:
 - a. Helicopter payload and duration reduces with "hot and high" conditions. At midday in high temperatures, some helicopters may only be capable of flying for a few minutes with reduced payloads.
 - b. Even with NVD, night flying operations may be constrained by lack of ambient light. During periods of no moon or mist, light levels may fall below the minimum necessary for night flying.

Firepower

57. Desert conditions by themselves do not reduce the effectiveness of the firepower available to modern armies. However, the problem of observation and accurate target acquisition, particularly in poor visibility, can inhibit the use of longer range weapons and can restrict the advantage of heavier supporting weapons. Despite this, artillery and mortar fire of all types can be particularly effective in halting an enemy's advance or his withdrawal. In addition artillery has the capacity to disrupt lines of communication and contribute substantially to both deep and close operations.

58. Manportable rocket launchers, grenade launchers, as well as hand grenades have all provided their worth against armoured vehicles and bunkers under almost any conditions and their usefulness in the open battle areas available in desert operations could be enhanced.
59. The firepower available in attack helicopters can materially assist troops operating in the desert provided suitable visibility is present.

Protection

60. All round protection, whether on the move or halted, is absolutely essential at all times. In defence the subtle use of any natural features available. The relative lack of cover during daylight, from both ground, air and sensor observation, can reduce the opportunity for infiltration, deception and ambush. Strict track discipline and control is necessary to keep enemy observation to the minimum compatible with good security.

Information and Intelligence

61. **General.** As in every other theatre of war, a major difficulty faced by the commander will be the problems encountered by his G2 staff in providing him with accurate and timely intelligence. In desert operations these difficulties will be exacerbated and while the intelligence cycle (see JSP 120 *Manual of Service Intelligence* for further details) remains unaltered by external influences, the collection of information and intelligence and its subsequent dissemination will be made infinitely more difficult by the speed and pace of operations.
62. **Direction.** In defining his Critical Information Requirements (CIRs), the commander should consider the effects of any desert terrain on his own and the enemy's operations. The Battlefield Area Evaluation (BAE) carried out in the course of his Intelligence Preparation of the Battlefield (IPB) will therefore be of particular importance in its consideration of routes, going and the effect of inadequate mapping. Particular requirements for information on the enemy (activities and intentions) will be expressed as part of his Priority Intelligence Requirements (PIRs), which will provide G2 with direction and will be used to formulate the Intelligence Requirements (IR) which make up the G2 Collection Plan.
63. **Collection.** The Collection Plan is the means through which the Reconnaissance, Intelligence, Surveillance and Target Acquisition and Reconnaissance (ISTAR) assets required to meet the commander's PIRs are tasked by the G2 staff. Depending on the content of the PIRs, appropriate assets may be found within the formation or the tasking may have to be passed to RISTA assets belonging to, or capable of being tasked by, a higher formation.
64. **Dissemination.** The effects of the desert environment on communications and of the speed of physical movement, will have a corresponding impact on the dissemination of intelligence. Allowance has to be made for the fact that intelligence (together with plans and orders) may take longer to reach its intended recipient and decision and planning times may have to be adjusted accordingly. Novel methods for the dissemination of intelligence may have to be devised and adopted and at the

planning state of operations a requirement for the capability to transmit imagery and mapping electronically should be considered.

65. **The Area of Intelligence Responsibility.** The Area of Intelligence Responsibility (AIR) of a tactical commander is likely to cover a large geographical area and adequate information and intelligence may be difficult to acquire. HUMINT from local inhabitants and PWs is likely to be sparse and, apart from any organic manned reconnaissance, the commander will have to rely to a considerable extent on IMINT and SIGINT from higher formations to meet his information and intelligence requirements.
66. **Operational Intelligence.** Intelligence at the operational level is outside the scope of this publication (for further details refer to AFM Vol 1 Part 1, *Formation Tactics* and JSP 120). However, due to the relative scarcity of ISTAR assets at the tactical level, and the probable large AIRs, units may have to rely on higher formations for a considerable proportion of their information and intelligence. Due to the lack of in-country logistic facilities and the probable reliance on a few vital supply routes, intelligence at the operational level will often concentrate on identifying the enemy's CSS assets and his Main Supply Routes as pointers to the strengths, locations and intentions of the combat troops.
67. **Information and Intelligence Requirements.** At the outset of operations the scarcity of intelligence at the tactical level will probably dictate that the operations are aimed at acquiring intelligence, rather than the destruction of any enemy forces. The extent of the tactical commander's AIR, and the few limitations imposed on his organic ISTAR assets by the desert environment, may mean that higher formation assets such as Special Forces (SF) patrols and access to strategic sources will be needed to provide information and intelligence otherwise unavailable at the tactical level. The Commander's tactical information and intelligence requirements will include:
 - a. *Terrain.* Detailed terrain information which is not available from existing mapping can be obtained by patrol activity or from imagery sources. Where imagery is not available and the areas are outside the range of the commander's organic reconnaissance assets, it may be possible to use SF patrols controlled at the operational level to obtain information about the terrain in the Area of Operations (AO).
 - b. *Enemy Strengths, Identification, Locations and Intentions.* Information and intelligence about these aspects of the commander's PIR may be obtained from:
 - (1) *HUMINT* obtained from contact with the local population and PW. However, by virtue of the desert environment, such contact will be, of necessity, sparse. Operations to acquire HUMINT are well suited to SF where they are available in theatre.
 - (2) *SIGINT*, in its various forms, can provide useful information and intelligence about the identity, location and equipment of the enemy and may also provide some indication of his intentions. SIGINT is likely to be provided from a higher formation.

- (3) *IMINT* may be restricted by the climatic conditions existing in desert terrain. Where available, *IMINT* can provide information and intelligence about the enemy's location, strength and equipment. *IMINT* will, except where the formation possesses integral UAV assets, be disseminated from a higher formation.
68. **Electronic Warfare (EW).** Despite the unpredictable effects of desert terrain on the electro-magnetic spectrum, the possession of an EW capability will provide the commander with a wide range of information and intelligence and will also enable him to attack the enemy's Command and Control (C2) systems. Although ground based EW equipment can provide a more effective long term capability than airborne assets, the ease with which it can be deployed, relatively close to its target in desert terrain will enhance its usefulness.
69. **Surveillance.** There is a wide range of equipment which is available to units and formations to improve their surveillance capability; Global Positioning System (GPS) as a navigation aid, Thermal Imagery (TI) Image Intensification (II) devices for use at night or in poor visibility, Laser Range Finder (LRF) and improved communication systems. While much of this equipment has not, so far, been used extensively in a desert environment, it has the potential to bring a considerable improvement in surveillance capability to these types of operation. While surveillance and target acquisition are strictly part of any gathering of information and intelligence function, their more detailed aspects are not covered further in this Chapter.

Combat Service Support (CSS)

70. The principles of good combat service support pertain equally to desert operations as to any other operational area, but the nature of the environment and its conditions could impose some severe and real constraint on normal operating procedures and methods of support. *ADP Vol 3 Logistics* provides a general background on the principles of CSS.
71. It should be normal practice to assume that the enemy could have the ability to cut or disrupt the lines of communication. Alternative means of resupply and casualty evacuation should always be considered and contingency plans prepared for such a situation along with sensible plans for protection, surveillance and effective communications links.
72. Planning for CSS is described in *AFM Vol 1 Pt 6 on Combat Service Support* and also in *AFM Vol 1 Pt 1 Formation Tactics*. Those aspects that have particular relevance to desert operations are reiterated below:
- a. *CSS Framework.* Integrated with operational plans should be a CSS plan which provides effective CSS activity within a framework of reliable communications and simple staff procedures.
 - b. *Preparation Time.* Forward thinking by a commander and staff to allow adequate time to assemble sufficient stocks and to cater for the unexpected.

- c. *Opportunity.* CSS activity is best achieved out of contact with an enemy and when this occurs every chance should be taken to resupply, evacuate casualties, and to repair equipment. In desert operations constant awareness of the current situation is the only sure means of anticipating opportunities, or equally important, a change in the weather conditions. An effective CSS framework will also enhance the ability to react quickly to events as they occur.
- d. *Distance.* A careful balance of factors is needed to ensure that CSS units are close enough to sustain operations properly but are at a sufficient distance away to avoid enemy attention. In the circumstances of desert operations this balance is probably fundamental to the success of any operation and will require constant review by a commander and his G1 and G4 staffs. The factors involved on any CSS decision are likely to be, the value of destruction, the rate of demand, distance and duration coupled with weather and terrain. There is very little room for error and it may be appropriate, despite the additional overheads, to have more forward dumps with fewer stocks in each to offset potential shortages.
- e. *Logistic Control.* Close application to the principles of command is essential to ensure that the logistic disadvantages of fighting in the desert are overcome. A study of ADP Vol 2 *Command* and the relevant logistic sections of AFM Vol 1 Pt 1 *Formation Tactics* is directly applicable to all unit and formation commanders. A basic requisite of logistic control in these conditions is that of centralised planning at the highest appropriate level followed by a rapid decentralised execution; in that way the normally scarce resources can be utilised in the most efficient manner. Once operations start the problem of communication, liaison and logistic control effectively and rapidly devolve down to subordinate staff and commanders.
- f. *Protection of Lines of Communication.* Protection and security for the lines of communication between bases and forward troop positions is vital for the cohesion of all operations in desert terrain.

COMMUNICATIONS PLANNING

1. The following additional points concerning communications in desert areas have been obtained from a recent large scale exercise in these environmental conditions.
2. Until suitable replacements for CLANSMAN and SCRA are in service it is not likely that range and reliability of communications can be guaranteed. Planners and operators should be aware of these shortcomings and make whatever suitable procedural fixes are possible to overcome this growing problem.
3. Rising temperatures in desert areas can cause the range and quality of VHF radios to decrease. The effects can be minimised by:
 - a. Use of ACU.
 - b. Separating radio sets to allow air to flow between them.
 - c. Using frequencies in the range 50-68 MHz as these are least affected.
 - d. Utilize low power as appropriate.
 - e. Shielding VHF equipments from direct sunlight.
 - f. Reducing temperatures in communication vehicles.
4. Trunk links suffer from degraded signal strength at dawn and dusk. The effects can be minimised by:
 - a. Using Band 1 frequencies whenever possible.
 - b. Keeping link lengths down.
 - c. Minimising the use of SHF during these periods.
5. Employ a back-up system, such as Inmarsat when establishing communications.

CHAPTER 3

OFFENSIVE OPERATIONS

SECTION 1 - INTRODUCTION

1. ***A Pattern of Desert Operations.*** The desert, and the steppes, lend themselves to mobile warfare in its purest form. Battle there most nearly approaches the theoretical perfection of the force on force engagement. A commander will aim to seek a decision, smashing the enemy's armour, and then surrounding and annihilating the hostile remnants in the open desert. Ideally, this may be achieved by encirclement. Failing that, a pursuit may accomplish the same result. The victor will attempt to reach and seize the next defensible position where he will be forced to pause to bring up supplies and reorganize his LOC before pressing on with a further advance. As in other environments the pace alternates between the frantic activity of battle, a race to repair and replace battle damage and build up resources for the next trial of strength, and long periods of inaction between them. Because the open desert lends itself to heavy attrition rates and battles of virtual annihilation the tempo tends to be faster and the demands on men and machines heavier than in closer country. The weaker side will cling to the best defensible position available while the stronger attempts to bypass it where possible or breach and break through it where it is not, or to do both when the enemy holds an attenuated line stretching miles into open desert from one secure flank. Opposing forces tend to keep further apart from each other when not engaged in battle than in other environments. They are protected by mobile covering forces which operate further forward than in closer European terrain. Extra space buys more warning time when a hostile threat may develop very quickly; it also provides more room for manoeuvre. Formation and unit frontages are apt to be wider than in Europe, posing additional problems for commanders with regard to security and outflanking action.
2. ***The Types of Offensive Action.*** The five main types of action are covered in the following Sections but are preceded by a Section on reconnaissance and surveillance.

SECTION 2 - RECONNAISSANCE AND SURVEILLANCE

Aims

3. The aims of surveillance and reconnaissance are fundamentally fourfold, to:
 - a. Provide security against a surprise enemy move or attack.
 - b. Discover as much as possible about the enemy's dispositions, habits and intentions.
 - c. Acquire targets for engagement by artillery, attack helicopters and FGA aircraft.
 - d. Obtain information about desert going and terrain, especially when the existing mapping is inadequate.
4. Subsidiary but important roles in the desert are raiding and playing a part in the

commander's overall deception plan. Special forces, such as the SAS, may play a prominent part in both roles.

The Terrain Problem

5. The desert differs from other theatres in the immensity of the space to be watched. There will often be an open flank stretching for hundreds of miles, and threats can develop from a greater depth much faster than in European terrain. Observing it for wide enemy outflanking moves and even wider ranging reconnaissance and raiding parties calls for more surveillance and reconnaissance resources than elsewhere. Access to a satellite system and arrangements for passing the information it provides quickly to the various headquarters which need it are of immense value. It is important that all resources are coordinated in a comprehensive surveillance and target acquisition plan. The manner in which medium and close ground reconnaissance are used to complement long range surveillance is described later in this Section.

Covering Force Activity

6. ***Time and Space Factor.*** The distance the covering force operates ahead of and to the flanks of a main forces depends upon suitable features upon which to base a line of observation, preferably high ground or an obstacle like a sand sea with few routes across it, and the time needed to warn troops, and especially the force commander, so that he has sufficient time to redeploy his formations or save precious hours in the mounting of a countermove. Usually, it will operate within MLRS range. It will normally operate much further forward of the main body than a European setting.
7. ***Grouping.*** The composition of the covering force will depend on the nature of the ground and the threat. While based on an armoured formation, reinforced by armoured reconnaissance regiments and helicopters, the forward screen may need extra infantry to hold high ground and defiles, engineers to mine vulnerable approaches. It will also require some armour and sufficient artillery support to enable the covering force to maintain itself in position against enemy reconnaissance and minor probing attacks short of a full scale offensive. Artillery, particularly MLRS, may be used aggressively in conjunction with the information provided by satellite imagery, air reconnaissance, armoured reconnaissance, helicopters and other surveillance devices to destroy significant enemy concentrations. To coordinate the reconnaissance and fire power assets of and available to a formation the medium reconnaissance regiment, artillery and aviation may best be grouped under the senior artillery officer, who will also coordinate the close air support effort allotted to the formation. Ideally, the whole covering force should be included within the air defence envelope within the theatre.
8. ***Helicopter Support.*** Reconnaissance helicopters are an essential element of a covering force or screen. They can be used to extend the ground surveillance systems, especially to watch the inevitable terrain gaps and to investigate reports of enemy activity which have been reported by other sources, such as the air force, satellite or radio intercept. Reconnaissance helicopters work in conjunction with and normally under the tactical control of the armoured reconnaissance regiment in whose area they are operating. They are vulnerable but in the open desert with its long fields

of view it is possible to give them some protection in the visual surveillance role by operating them well behind the forward troops where they can fly sufficiently high, and in reasonable safety, to obtain a good view over the haze and dust. They are also useful for lifting in dismounted OP parties with their equipment to places inaccessible to vehicles and for withdrawing them, either on redeployment or if the screen is driven in. Attackhelicopters can provide a concentration of anti-tank firepower quickly to meet a sudden threat or, in a more offensive role, to help to destroy lucrative targets in order to inflict attrition on the enemy.

9. **Surveillance Coverage.** Because darkness still offers opportunities for surprise the night surveillance coverage has to be as thorough as in daytime. Elevated OPs are not only useful for the extra ground they can cover but also because visibility is much better from a level just above the heat haze. The role of the covering force is discussed in greater detail in the Section on Defensive Operations.

Reconnaissance

10. **Function.** The introduction of satellite imagery and JSTARS, together with improvements in air reconnaissance, have led to a revision of the employment of medium and close reconnaissance. These sources provide so much information, particularly in the desert, that ground reconnaissance no longer has to grope blindly for the enemy. The vulnerability of reconnaissance vehicles on the move to detection by thermal imagery operated from stationary vehicles or static OPs is far greater in the desert than in European terrain. Consequently, it is more necessary than ever for medium and close reconnaissance to use stealth in the open. Even in the flattest of deserts there are occasional declivities and small rises in the ground to give some cover from enemy ground surveillance. Instead of moving forward during an advance on a continuous broad front to make chance contact and suffer unnecessary casualties reconnaissance units can be tasked to answer specific questions based on an analysis of information already available from satellites and other sources such as ESM. In deep operations, MRLS and other divisional assets would normally cover medium reconnaissance. When serious opposition is expected and it is necessary to fight for information, tanks, supported by artillery and armoured infantry, should take the place of medium reconnaissance.
11. **The Reconnaissance Requirement.** In the light of the information acquired from the long range sources mentioned above the higher formation commander may need medium reconnaissance units to fill out his picture of enemy and ground. There is still a role for manned reconnaissance which can provide value judgements and answer requests for supplementary information. Further tasks may include:
 - a. Obtaining more information about apparent gaps in the enemy's defences and obstacles.
 - b. Proving bypass routes.
 - c. Checking the extent of the hostile ground-based electronic surveillance coverage.
 - d. Verifying the state of the ground in specific areas where the going maps have been dependent solely on satellite imagery or air photography.

12. **The Reconnaissance Plan.** The plan will be complementary to the intelligence preparation of the battlefield. It will be formulated in conjunction with the air force. If the commander has an offensive in mind he and his staff will issue a policy concerning not only the information they need for planning purposes but the pattern of reconnaissance he wishes to simulate to mislead enemy intelligence as part of the deception plan.
13. **Extending the Range of Medium Reconnaissance.** In the desert the opposing forces may be some distance apart and it may be necessary to establish forward patrol bases surreptitiously behind terrain screened from enemy surveillance from which OPs and patrols can be sent out on missions. To cover large distances it may be possible to expand on the use of helicopters, mentioned earlier, to fly patrols forward under terrain screening to establish OPs to watch the next bound carefully for signs of enemy activity. If the information is negative the patrol can be lifted forward to the next feature by the route which offers the best terrain cover. The process can be continued until contact with the enemy is established. Even more so than in other theatres it may, on occasions, be necessary to fight for information to establish the enemy's positions, artillery DF plans and reactions but this is a task for armour supported by artillery and armoured infantry, not medium reconnaissance units. Otherwise, the emphasis will be on stealth in a surveillance screen. Reconnaissance vehicles may often be dug in and both the vehicle and the OP based on it have to be well camouflaged. Although reconnaissance units feel very exposed so far forward there is usually so much activity in the desert that small groups of vehicles are apt to escape notice. If there is a possibility of being compromised the patrol commander has to decide whether to drive fast for the nearest cover, relying on speed to escape punishment, or to drive very slowly so as not to raise dust in the hope of not being noticed.

Long Range Reconnaissance and Raiding

14. **Roles.** The main roles of long range reconnaissance and raiding in the desert are:
 - a. The covert reconnaissance of enemy positions in depth to establish locations and patterns of behaviour while the enemy is unaware that he is being observed. Burst and coded transmissions can be used to report real time information.
 - b. The reconnaissance of enemy headquarters, airfields, air defence systems, missile sites and key logistic installations with the aim of attacking them in conjunction with a main force operation, engaging them with long range artillery fire or directing armed helicopters or ground attack aircraft on to them, either visually or using laser designators.
 - c. Route watching to establish traffic patterns and the move of enemy formations, particularly reserves and newly arrived units. While sensors can count the number of vehicles passing a given point they can be used to pass false information if the enemy finds them. Satellites give good general surveillance but sometimes human judgement is useful.
 - d. Raids to capture or kill commanders or specialist personnel and to remove

enemy equipment for intelligence analysis. These should be carried out by raiding forces, such as the SAS, and not specialist reconnaissance forces, whose patrols are small and whose expertise is sometimes even harder to replace.

- e. Distraction and deception operations.
 - f. Rescuing downed aircrew.
 - g. Survey, the reconnaissance of gaps round an enemy's exposed flank or through supposedly impassable obstacles and the compilation of going maps behind the enemy's lines in conjunction with photographic air reconnaissance and satellite imagery to assist the force commander in future planning.
15. **Command and Control.** Private enterprise can result in the proliferation of long range reconnaissance and raiding units. It is necessary to control their numbers and coordinate their activities so that they work within the framework of the force commander's concept of operations to obtain the information he and his staff want and do not prejudice the security of his plans, real or deceptive. It is also important that one organization does not blow up what a second is trying to photograph and a third is planning to recover for detailed investigation. Equally it is essential to coordinate long range reconnaissance and raids with the air force to avoid friendly air attack, to prevent the confusion of photographic reconnaissance and satellite imagery, and to arrange any offensive action, either in close support or as a distraction, air resupply and casualty evacuation. For these reasons it is advisable to provide a special forces element in the theatre headquarters. The CSS support of long range reconnaissance requires a considerable effort in the building up and camouflage of supply dumps in the desert. A balance has to be struck between range and armament. The more distant the objective the more fuel must be carried at the expense of heavy weapons. However, the increased chances of achieving surprise against a distant objective may compensate for the lack of heavy weaponry.
16. **Means of Insertion.** These include:
- a. Overland by routes which the enemy least expects.
 - b. Landing craft or submarine (where appropriate).
 - c. Helicopter along routes shielded by terrain.
 - d. Parachute.
17. **Vehicles.** The light strike vehicle, easily airportable, capable of carrying MILAN and the M19 40mm grenade launcher, is particularly suitable for long range reconnaissance, backed by the medium support vehicle. Vehicles should be painted in such a way as to reduce their infra-red signature. Anti-aircraft missiles are an essential defence against the long range patrol's main threat, air attack. When reconnaissance and raiding forces have to be supported at very long distances from base it will be a matter for careful judgment as to whether their CSS vehicles should have four-wheel

drive, in which case they will use up extra fuel, or whether vehicles with good rear wheel traction, and which consume less fuel, will suffice. Whatever vehicles are used for reconnaissance and CSS they have to be carefully racked to carry fuel and stores over hundreds of miles of bad terrain without damage.

Aids to Surveillance

18. **Infra-red.** This is of little practical use in the desert because any smoke or dust defeats it.
19. **Image Intensification.** Effective at night provided there is some starlight. It is particularly useful for individual weapon sights and as a night driving aid. However, smoke and dust defeat image intensification.
20. **Thermal Imaging.** A most effective aid. It alleviates all effects of heat shimmer to provide a greater accuracy of engagement than any other system. It discriminates between tanks in use by the enemy from those that have been knocked out. Tanks heat up more than sand and can be detected against a sandy background after sunset. However, rocks will continue to give off a hotter signature than metal for up to four hours after sunset, although a tank with its engine running can still be detected. Thermal imager operators have to become familiar with the signatures of tanks, vehicles, sand and rock by day and by night and during the transition periods of 'thermal twilight' at dawn and dusk. The worst times are approximately an hour after sunset and an hour before sunrise when operators may have some difficulty in obtaining sufficient resolution between target and background. The trouble can usually be overcome by adjusting the contrast or the temperature window of the imager. Similar problems occur when looking into a low sun at dawn and dusk which can wipe out the thermal picture. Thermal imagers can pick up the enemy's active imaging systems and operators have to learn to recognize the reflected light from laser range-finders which confuse those who are unfamiliar with it. Concealment camouflage sets can reduce vehicle signatures but they must be used with care because they can give a cooler return to thermal imagers than the surrounding ground. Thick dust presents a major problem, particularly the massive clouds thrown up by concentrated artillery fire, which may be used to screen movement. Thermal systems cut through light or moderate dust to give a high resolution picture of metallic objects such as tanks and IFVs.
21. **Seismic Sensors.** Works well on gravel and rock but are degraded by soft sand.
22. **White Light.** This is a two-edged weapon, blinding drivers and weapon operators, revealing one's own position and 'whiting out' image intensification sights. However, on a pitch black night there may be no alternative to white light, especially if the defenders have been surprised and are in danger of being overrun. Artillery and medium mortar illuminating rounds can be set to burst on impact in dead ground behind the enemy. Similarly, light mortar illuminating rounds can be fired on a low trajectory with the same object. The enemy will be silhouetted and image intensification weapon sights should not suffer 'white out'. If they do, iron sights will still be effective.
23. **Radar.** Useful in the middle of the day when the heat haze distorts vision but thick

clouds of sand and dust defeat it. Although its range can be optimised in the desert the enemy can detect it at four times its acquisition range so that it is vulnerable to ECM and homing missiles. For this reason the ranges of active emitters are usually limited. However, because there is often more space between opposing forces in the desert than in European terrain the option to extend the range to acquire early information is always open but it will have to be balanced against the risk of enemy retaliation.¹

24. **Covering the Arc of Responsibility.** Reconnaissance detachments and OPs will be given interlocking arcs of responsibility to ensure that the entire frontage and flanks are covered. Surveillance devices have limited fields of arc and there is a tendency to concentrate on expected enemy axes of advance at the expense of the remainder of the arc of responsibility which is likely to be wider in the desert than in other environments. Operators have to swing their optics regularly throughout the whole arc to guard against surprise.²
25. **Control of Battlefield Illumination.** Because the desert is so open and in places totally devoid of cover, the indiscriminate use of illuminants, particularly during a night advance or attack, can expose troops to damaging enemy fire up to great distances. In an offensive action the control of battlefield illumination should be vested in the headquarters which is controlling the operation as a whole. In defence, control will usually be delegated to a low level unless the higher formation commander's plan is to lure the enemy into a trap, in which case some constraints may be placed on the use of illuminants without reference to his headquarters. In the overall plan for a battle the use of illuminants by the air force may also have to be coordinated with the ground plan.
26. **Visual Confirmation of Sensor Sightings.** Turning data into intelligence and from intelligence into targets takes time, particularly at the beginning of a campaign when systems operators and intelligence analysts are inexperienced. A decision on whether to engage a target solely on the picture provided by an electronic sensor can only be decided in the light of the circumstances. Factors to be considered may include:
 - a. The exactness of information on the whereabouts of own troops in relation to the enemy.
 - b. The degree of degradation of the sensor due to sand, dust, smoke, light conditions and other physical factors.
 - c. The experience of the sensor or weapon operator.
 - d. Confirmatory evidence from other sources.
 - e. The extent to which known enemy electronic equipment signatures can be readily recognized.

1. During Operation GRANBY the range of the manportable surveillance and target acquisition radar (MSTAR) was extended from 6 to 20 miles.

2. The IDF are at pains to emphasise this point as a result of their experience in recent conflicts.

- f. Balancing the risk of using white light to make a positive identification to avoid engaging friendly forces against the risk of disclosing one's own positions prematurely.
 - g. It may be necessary to issue rules of engagement to avoid accidents. Subsequently, the rules have to be reviewed whenever the situation changes.
27. **Intelligence.** Allied to and controlling reconnaissance is the overall intelligence policy. Intelligence is easier to run at the operational than at the tactical level. At the latter level the need is to provide the answers to specific questions quickly. The overcentralization of the intelligence effort must be avoided in the interests of speed. Divisional commanders need to have some surveillance devices under their control if they are to obtain timely information on critical matters. As mentioned earlier, air photographs and satellite imagery are a most useful adjunct to planning, briefing and issuing orders when the available mapping is inadequate.

SECTION 3 - THE DELIBERATE ATTACK

General

28. When the enemy is firmly established in a defensive position, the flanks of which are secured on features which cannot be turned, a deliberate assault will be necessary to break through and dislodge him. Such a situation may occur when confronted by prepared positions on a frontier or at the end of an advance to contact or pursuit where the defender has been able to take up and prepare a strong position. If there are serious obstacles, such as deep minefields, anti-tank ditches and sand embankments a special breaching operation will be required and it may be necessary to secure a lodgement area on the fro side to cover the completion of the gaps and the passage through of the armour to defeat the enemy mobile forces on the far side and to exploit. Powerful artillery support is required to suppress the enemy defences, particularly his ATGWs and to neutralize his guns in a situation where our own armour, the engineer breaching force and infantry are very vulnerable in such open terrain. Breakthrough operations are expensive in casualties and time and should be avoided if there is any practicable alternative. Casualties may be reduced by the use of air delivered fuel/air weapons to soften up the defences and to detonate mines. As a rough rule of thumb the attacker will need a superiority of about 3:1 to succeed.

The Deliberate Attack

29. **Attacking the Covering Forces and Screen.** If the rival forces are already in contact it will be necessary to dominate no-man's land with patrols, ambushes and fire in order to deny the enemy reconnaissance of the FLOT and to enable close reconnaissance of his obstacles and positions to be conducted. At the end of an advance to contact or a pursuit it will be necessary to drive in the enemy's covering forces, guards and outposts as a preliminary to close reconnaissance.
30. **Initial Reconnaissance.** Initially, ground reconnaissance will concentrate on gaining a general picture of the forward edge of the enemy's positions, his minefield pattern

and of the state of the going while satellites, drones and the air force reconnoitre his defensive layout in depth as well as providing information on which to base the reconnaissance plan. In the meantime, the electronic spectrum is searched to monitor his communications and to discover the location of his surveillance devices. As important as pinpointing the position of the latter is determining the extent of the ground which the enemy can observe and that which is screened by terrain features. In the desert where there is virtually no natural cover the discovery of approaches which are masked from visual and electronic surveillance, at least from ground stations, will influence the commander's plan. If the attack is to be made by units currently in reserve it will be necessary for them to set up OPs and provide patrols to operate from the units already deployed on the FEBA, making use of information already discovered by the latter. The need for the units nominated to execute the attack to obtain first hand information has to be balanced against prejudicing security by the loss of prisoners. The whole patrol and information gathering plan needs to be coordinated with the deception plan. Any deep patrolling necessary should be carried out by the formation occupying the FEBA. The difficulty of passing information between formations will present special problems in an allied force and should not be underestimated.

The Commander's Concept

31. Based on the information his intelligence staff have been able to collect, the commander will decide on his design for the battle. His concept for destroying the enemy will include the points mentioned below:
 - a. Key terrain.
 - b. Approaches to key terrain.
 - c. Timing (day/night/moonlight).
 - d. Rugged terrain.
 - e. Flat terrain.
 - f. Phases and forward passage of lines.
 - g. Frontage.
 - h. Planning and beach operations.
 - i. Mine clearance.
 - j. Traffic control.
 - k. Surprise and deception.
 - l. Air defence.

The Assault

32. **Further Preparations.** Once the plan has been prepared further reconnaissance, concentration and regrouping of forces and movement to forward locations would proceed. At the same time efforts should be made to ensure that electronic emissions do not give away these preparations and yet do not impair the coordination of any attack plans.
33. **Breaching Operation.** While any breaching operation is in progress and the first squadron/company groups are passing through the lanes cleared of mines or through gaps bulldozed in sand berms tanks should be deployed in hull-down positions along the old FLOT to give direct fire support to supplement the artillery preparatory and covering fire. Ideally, the tanks should be provided from follow-up squadron/company group tanks in the same battle group to ease the control and communication problem. The leading squadron/company groups should be given objectives the loss of which will deprive the enemy of immediate direct observation of the gaps through the minefields. The mechanized or armoured infantry should follow the leading tanks through the gaps mounted in their APCs or IFVs, both to protect them from enemy artillery and small arms fire and to ensure that they arrive on the objective together with the tanks. They should debuss to clear the objective while the enemy is still numbed by the artillery covering fire and supported by their affiliated armour and their own vehicle-mounted machine-guns. An example of layouts and groupings for obstacle crossing, the break-in battle and breaching operations are given in Figures 3-A to 3-E. There can develop serious difficulties in controlling a breach operation once started because of the presence of dust clouds. This has to be carefully considered in the planning of such operations and realistic ranges, objectives and navigational aids put in place.
34. **Strong Points.** Mutually supporting strong points may be encountered where there is no natural cover. They may be dug in flush with the ground or constructed by bulldozing sand into circular walls, which are revetted and surrounded by the ditch from which the sand was excavated, and encircled by a protective minefield. They will stand out prominently on air photographs and, in a deliberate set-piece attack, company groups will be detailed to storm them. Fire support will be provided by mortars and artillery, the company group's tank troop, IFV or APC machine-guns and dismounted infantry. The Baby Viper, or its successor, will be required to gap the protective minefield and ladders may be needed to scale the walls unless the attack can be directed through any gap which has been left for maintenance traffic.
35. **Smoke.** If there is little wind and heat, smoke rounds may be mixed with high explosive shells to thicken up the dust cloud raised by shell bursts. Usually, there is too much wind and heat for a smoke screen to be effective. There is the additional risk that if a smoke screen can be laid that tanks, APCs, IFVs and infantry will be silhouetted as they emerge from it not only in daytime but on a moonlight night. The assaulting combat teams may also be deprived of the support of the tanks in fire positions behind them.
36. **Keeping Direction.** Before the introduction of satellite navigation systems this was difficult in featureless terrain especially when the smoke and sand thrown up by shell bursts obscures what few landmarks there are. Magnetic compasses are useful dismounted but not much help in or near a vehicle. For navigation at the local, tactical level, discreet lights, tape and other marking on the start line and as far forward as

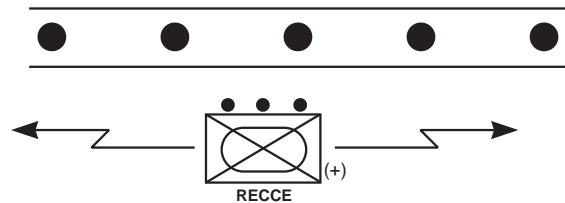
OBSTACLE CROSSING RAPID MINEFIELD BREACHING

NOTES:

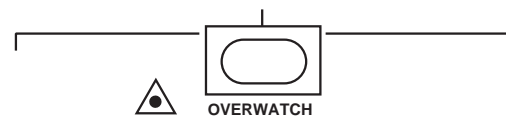
1. **Recce Gp.** Composed of recce pl and engr recce.

Tasks:

- a. Note dimension, etc.
- b. Send MINEREP.
- c. Recce route from Holding Area to obs and provide guides.

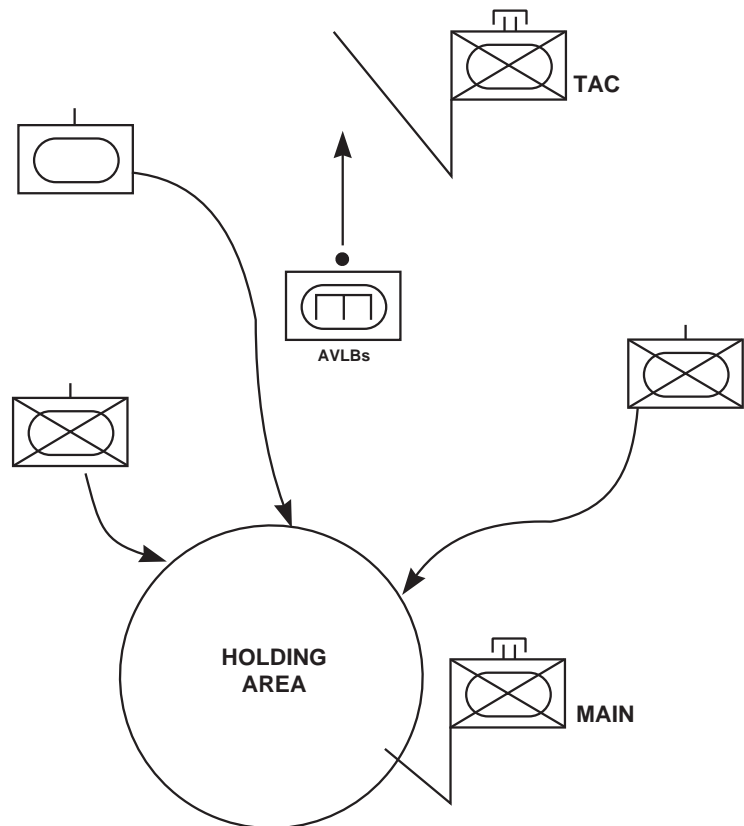


2. **Sqn/Coy Gps.** Initially, attempt a crossing using engr assets gp with sqn/coy gp. If not possible, due to en action, minefield breach will be coord at BG level.



3. **Comd and Con.**

- a. BG Tac HQ issues wng O, prep SOC Os.
- b. Breach comd either Bn 2IC in MICV or Altn HQ, depending on step-up situation. Etab check pt at easily recognisable loc in sight of obs.



4. **Home Bank Overwatch Sqn.** Nominated in wng O. Normally sqn whose axis leads into minefield. Affiliated coy moves to Holding Area as given in orders.

5. **Engrs.** Assets mov fwd under comd BG Tac HQ and tp comd. GV held in engr waiting area, ready to move up if required.

6. **Arty/Mors.** Deployed to cover crossing site and 3-4 kms beyond. Prep fire plan to cover engr work and mov of sub-units. FOO fwd with overwatch sqn.

Figure 3-A Phase 1 - Preparation

OBSTACLE CROSSING RAPID MINEFIELD BREACHING

NOTES:

1. **Engr.** Move fwd and fire GV on H hr, if incl in op. Prove lane with AVRE.
2. **Overwatch Sqn.** Push one tp through to estab foothold on far side.
3. **Bridgehead Gp.**
 - a. Consists of uncommitted sqn/coy gp, BG Tac HQ and recce elms.
 - b. Crosses once overwatch firm on en side.
 - c. Estab bridgehead to deny en obsn and direct fire on to crossing site. May involve sqn/coy gp attack on to en posns.
 - d. Drop off ARR/ARRV at crossing site.
4. **Bn 2IC/Altn.** Con mov fwd of vehs to crossing site.
5. **Arty/Mors.** Cover engr work and mov with HE and smk.
6. **Mob Milan.** Flank protection for crossing site.
7. **Rec.** Tks must be prepared to push dead vehs out of the way as pri task to prevent hold up.
8. **Recce.** Mark route from holding area to crossing site as follows:
 - a. Blue light - vehs turn right
 - b. Green light - vehs turn left
 - c. Red light - vehs straight on.
 - d. Clear lane will be marked with recce vehs and red lights, all transit vehs to pass to left of lights.

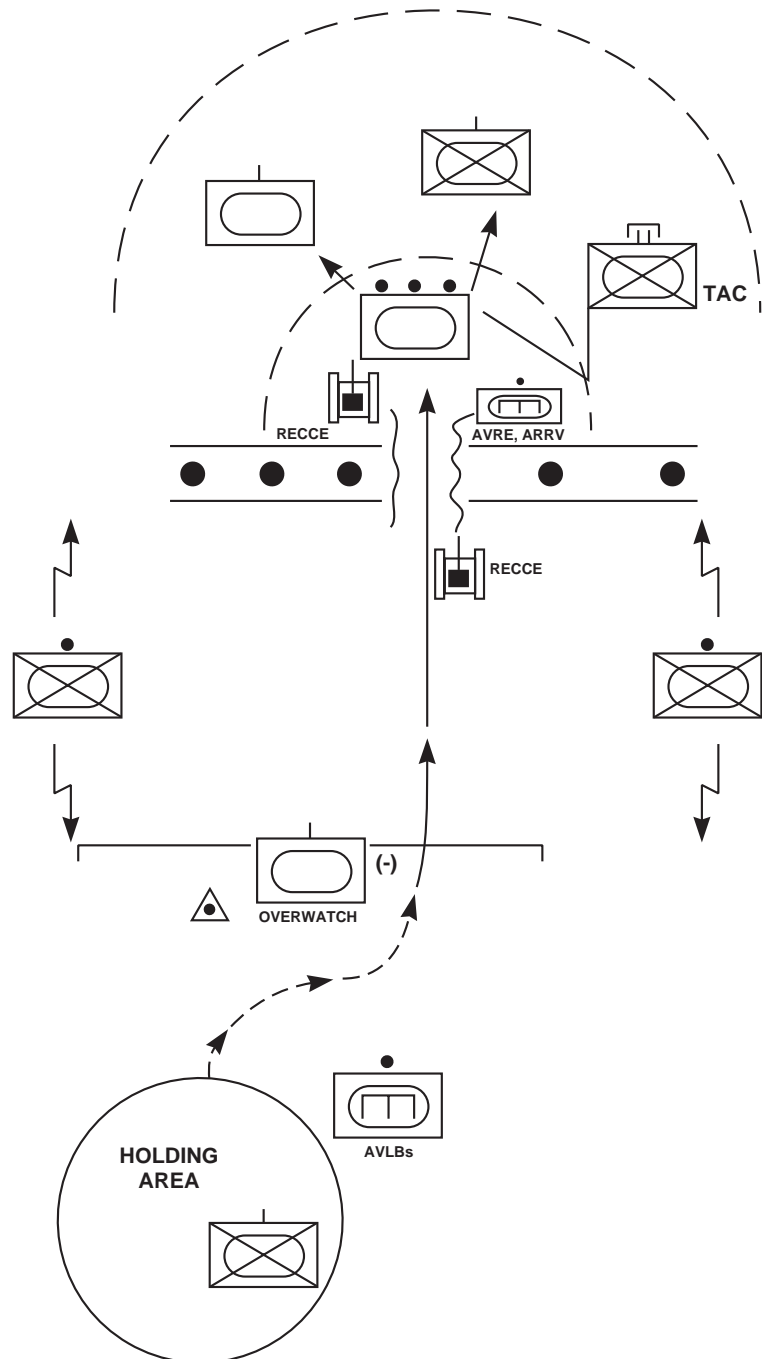


Figure 3-B Phase 2 - Establishing a Bridgehead

OBSTACLE CROSSING RAPID MINEFIELD BREACHING

NOTES:

1. **Exploitation Sqn/Coy Gp.**
 - a. Formed from overwatch sqn and affiliated coy.
 - b. On orders, cross obs. Sqn to pick up tp on en side.
 - c. Exploit up to 2-3 km out of bridgehead.
 - d. Pause to allow recce to push fwd.
2. **Recce.** Half recce gp cross obs and push on. Other half still marking route to crossing site. Defile marking as per SL/LD procedure.
3. **Engrs.** Fd tp improves crossing for wh vehs.
4. **Bn 2IC/Altn.** Mov up once A1 ech mov up to crossing site.
5. **Arty/Mors.** Mov coord by BC.
6. **Bridgehead Sqn/Coy.** Reorg. Prep to follow up on orders.

SILENT MINEFIELD BREACH

1. More deliberate op, aimed at achieving surprise. Involves dismantled engrs and close protection inf.
2. **Recce Pl.** Tasks as per rapid breach. Marking of clear lanes as per Rapid Breach, Phase 2 (Figure 3-B).
3. **Home Bank Overwatch Sqn.** Nominated in wng O. As per rapid breach.
4. **Close Protection Gp.** Provided by overwatch sqn and affiliated coy.

Tasks:

- a. Coy dismantles to provide close protection to engrs whilst they hand breach minefield on foot.
 - b. Provide home bank dismantled overwatch and man entrance to minefield gap.
 - c. Etab bridgehead perimeter (dismounted) on far side once breach is complete.
 - d. Hold ground and prevent en interference until uncommitted sqn/coy gp is pushed through.
 - e. Mount vehs and follow on as ordered.
5. **Remainder.** Wait in holding area until called fwd. Exploit breach as ordered.
 6. **Engrs.** Tasks:
 - a. Mov fwd and clear lane (dismounted).
 - b. Mark lane with minitape.
 - c. Liaise with recce and give clear lane details.
 - d. Clear other routes on orders.
 7. **Comd and Con.** Crossing site con by close protection gp coy comd who will be positioned at entrance to clear lane, until relieved by Altn HQ. OOM and timings as per orders.
 8. **Follow-on Phases.** As per rapid breach.

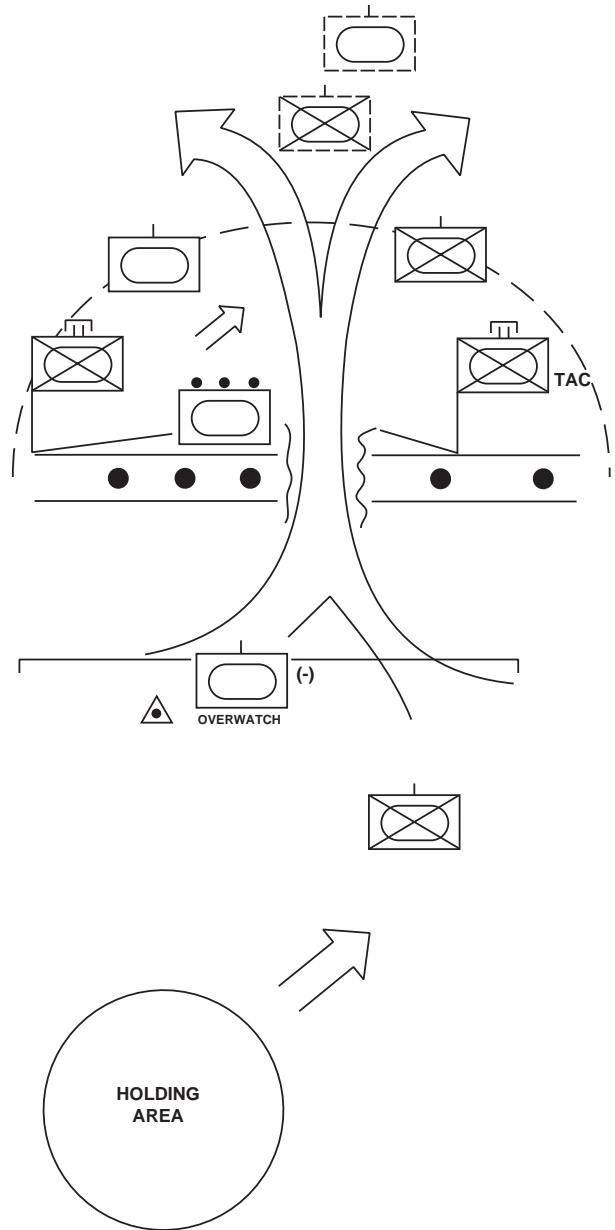


Figure 3-C Phase 3 - Breakout

ARMoured INFANTRY - HEAVY BRIGADE

1. Brigade normally conducts breaching operation on a two battle group frontage, approximately 4 km wide.
2. Each battle group with one armoured engineer squadron in support. Additional squadron from divisional assets. Attempt to force at least two to four breaches in each battle group area.
3. Battle groups support engineers, then cross obstacle to secure breach site.
4. Battle group commander is breach force commander, collocated with OC armoured engineer squadron. Battle group sub-unit commanders control lanes.
5. Maximum artillery support for breaching operation.
6. Brigade HQ acts as Regulating HQ.
7. Assault force (armoured heavy battle group) held back to pass through obstacle as soon as breaches are completed and breach site is secured.
8. Engineer field squadron ready to enhance and expand breach as soon as possible.

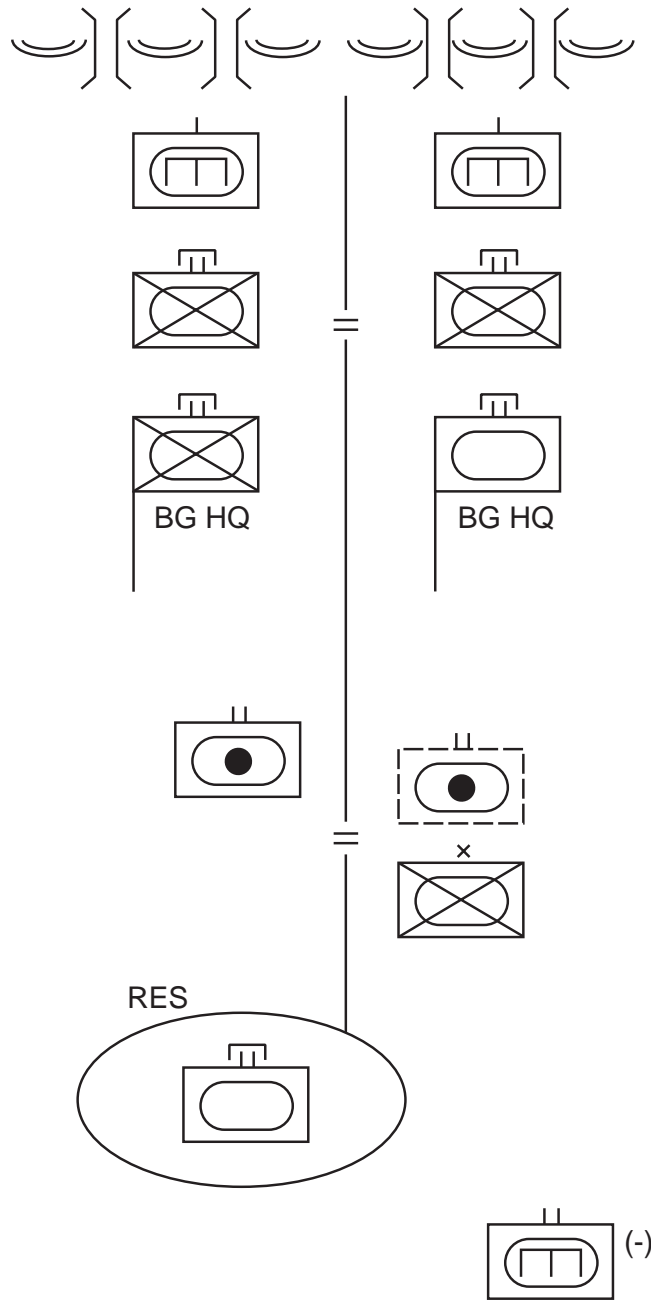


Figure 3-D Breaching Operations

ARMoured INFANTRY - HEAVY BRIGADE

Note. In this diagram the brigade is advancing down the page.

1. **Phase 1** - Engineers and breaching battle group(s) breach obstacle supported by artillery. Two to four breaches per battle group area.

2. **Phase 2** - Breaching battle group(s) secure breach site, expand secure area, control lanes at the crossing places, and assist forward passage of assault force.

3. **Phase 3** - Assault force crosses obstacle as soon as possible, preferably on two or more routes and exploits outwards. Reconnaissance pushes forward as quickly as possible.

4. Brigade HQ (Forward) follows across obstacle. Brigade HQ (Main) continues to act as Regulating HQ to assist passage of other formations/units.

5. Artillery supports all phases of breaching operation and moves forward to support assault force once lanes are clear.

6. Engineer field squadrons move forward quickly to enhance breaches.

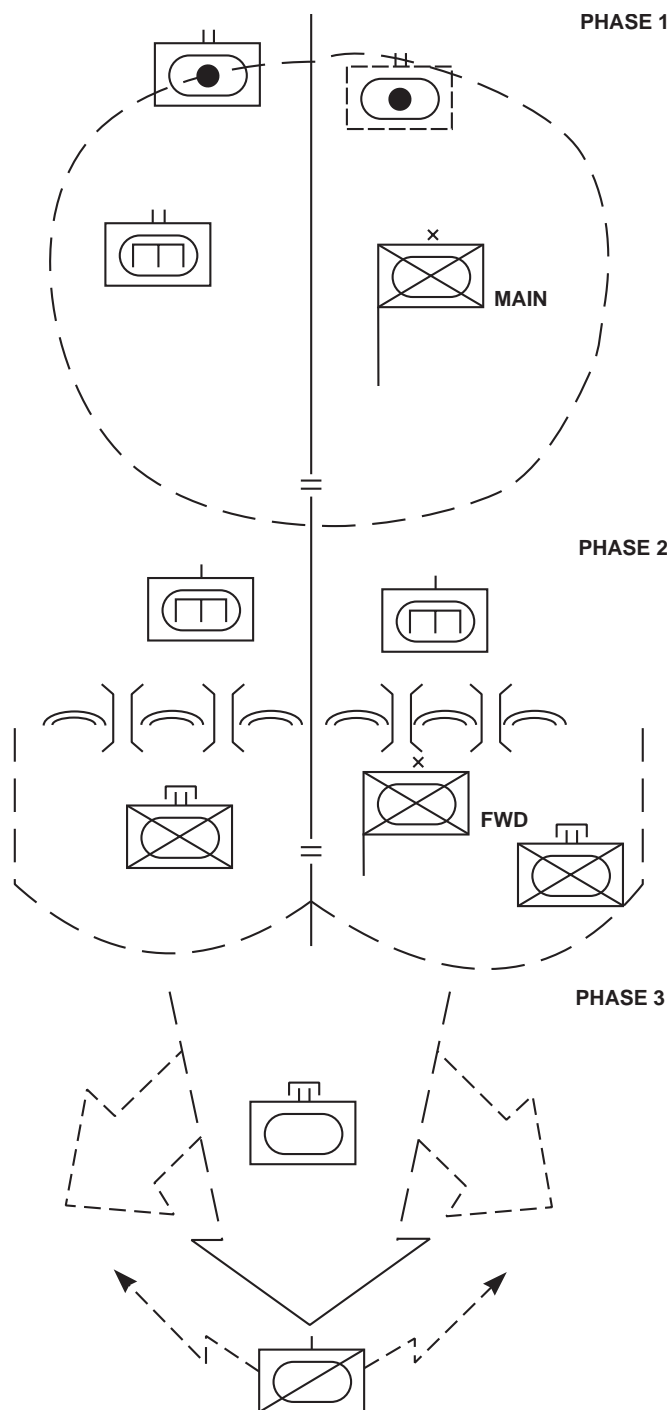


Figure 3-E The Break in Battle

possible, and then the furrows produced by the leading armoured vehicles through the enemy minefields, may be used to guide follow-up troops. It may be necessary to use vehicle rear lights at night (ensuring that the front sidelights are taped up). Cyalume markers on poles are a useful route marking aid. Further help may be given by firing tracer on fixed lines along the gaps. If the latter is used the searchlights should be positioned behind a feature sufficiently high to prevent the assaulting units being silhouetted against their glow. Two searchlights, shining vertically into the sky at known grid references, can provide markers for compass resection in the event of a breakdown on the satellite navigation system. Timed artillery concentrations are also a useful guide, provided that they are readily distinguishable from the rest of the fire plan. So, too, are white phosphorous rounds fired from tanks on to the centre of an objective or to identify points on an axis of advance.

37. **Establishment of the Bridgehead.** After the capture of the initial objectives to deny enemy observation of the gaps, follow-on battle groups will deepen and consolidate the bridgehead to allow engineers to improve the gaps into motorable wheel routes and bring forward reserves, field and air defence artillery. A traffic control system using up and down routes for each formation will be cleared, marked and patrolled by provost as soon as possible. Formation headquarters will nominate the routes for clearance. The formation in whose sector they lie is responsible for their clearance and marking until relieved by another formation or a suitable traffic organization.
38. **Armoured Battle.** In the light of the progress of the break-in battle the commander will decide on his next move in furtherance of his overall plan. One option might be to deploy the bulk of his armour in hull down positions in defence of captured key terrain, together with ATGW, to invite an enemy counter-attack in order to destroy his armour. Another might be to press on through a gap to encircle the enemy. The opportunity to combine both tactics may arise by luring the enemy mobile reserves into a counter-attack on one sector while pushing the bulk of his armoured forces through a gap to take the enemy in flank or rear. The object will be to oblige the enemy to commit his armoured forces to battle on the worst possible terms. Once his mobile reserves have been defeated the way is open for exploitation. Diagrammatic illustrations of a deliberate attack are shown in Figures 3-F to 3-H. The commander of a formation waiting to exploit a breach in the enemy defence should take three possible scenarios into consideration:
 - a. The enemy reserves are immobilised or slow to react so that there is sufficient space to deploy beyond the obstacle. In this case an armour heavy force can be pushed through to seek out and destroy the enemy reserves.
 - b. The enemy reserves are closing. The decision to lead with an armour heavy or infantry heavy formation will depend on where the commander expects the meeting engagement to take place. The aim will be to halt the enemy far enough out to deploy the whole formation so that all the manoeuvre and fire groups can be concentrated to destroy the enemy.
 - c. The enemy has counter-attacked. The infantry heavy formation will lead to continue the breakthrough battle, supported by additional engineers and all the firepower available.

DELIBERATE ATTACK

NOTES:

Action on Contact

1. **Recce.**
 - a. Immediate indirect fire.
 - b. Recce extent of en posn.
 - c. Loc fire base (FB), FUP/assy area, SL/LD.
 - d. Probe for depth posns.
 - e. Pl comd RVs with CO.

2. **BG Tac HQ.** Mov fwd to recce attack. RV with recce pl comd. Issue wng O to BG. Prepare and deliver SOC Os.

3. **Sqn/Coy Gp.** Await wng O and tasking by CO. Sqn nominated as firebase will also provide a two tp BG res. Remaining sqn will become asslt sqn, one tp to each coy as intimate sp tp.
 - a. *Two Axis Adv.* Left adv coy becomes left asslt coy, right adv coy becomes right asslt coy.

 - b. *Single Axis Adv.* Lead coy becomes left asslt coy, follow-on coy becomes right asslt coy. Lead sqn provides fire base and res.

4. **Arty and Mors.** Deploy into action as coord by BC/mor pl comd. Automatic conc of fire on en obj. BC produces SOC fireplan.

5. **Engrs.** Engrs allocated to sqn/coy gps to remain as grouped. AVLBs held by tp comd and to deploy as ordered.

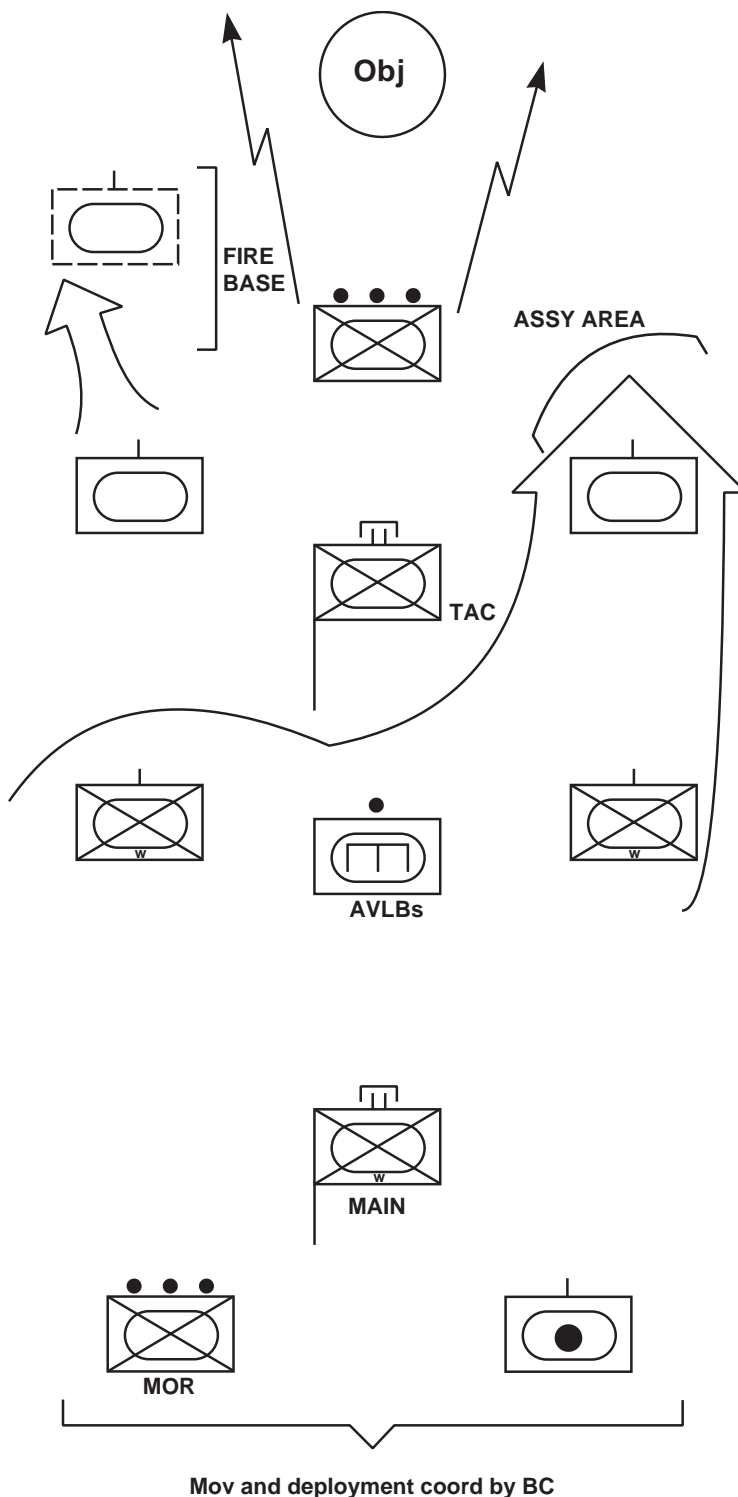


Figure 3-F Phase 1 - Deployment

DELIBERATE ATTACK

NOTES:

1. **Recce.** Recce pl marks SL/LD with three CVR(T)s:

a. *Day.* Flanking hulls point inwards, barrels towards en. Centre CVR(T) faces en.

b. *Night.* Left CVR(T) - blue torch. Centre CVR(T) - red torch. Right CVR(T) - green torch.

Recce pl guides sqns/coys fwd from assy area to FUP/SL/LD.

2. **Sqn/Coys.**

a. Sqn provides def screen in assy area. Intimate sp tps marry up with coys in assy area. Sqn movs to FUP/SL/LD deployed.

b. Coys mov fwd to FUP/SL/LD in pl columns. Milan sects from coys cover flanks.

c. Sqn/coy ambs regp with RAP to form amb fleet to be tasked as reqd.

3. **Engrs.** Travel centrally at rear. Deploy as ordered.

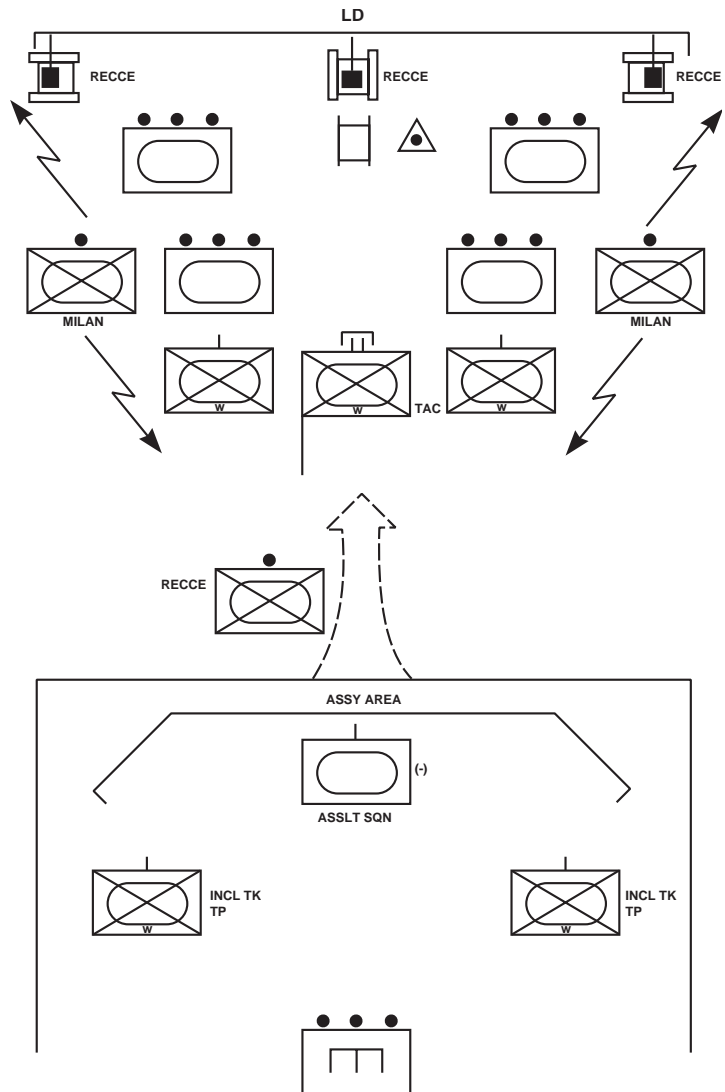


Figure 3-G Phase 2 - Move to FUP/SL/LD

ATTACK

NOTES:

1. **Fire Base.** Covering fire until last possible moment, then switch to altn tgts.

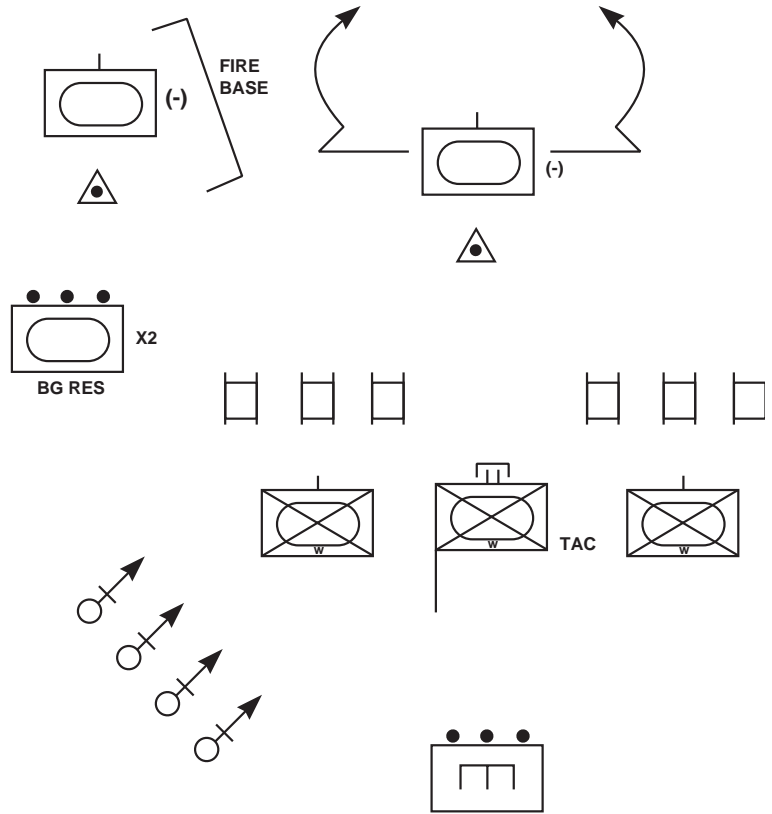
2. **Asslt Sqn.** Move fwd in extended line, firing on the move, then, depending on the atk def, either:

- Envelope with 'ring of steel'.
- Break through defs towards depth.
- Swing out to flank to sp fight through obj.
- Halt short of obj to shoot in inf from rear.

3. **Intimate Sp Tks.** Fight with coys.

4. **Coys.** Either:

- Dismount on FEED.
- Dismount within en perimeter.



Debuss behind intimate sp tks. MICVs from which inf have dismounted come under control of coy gunnery capt to provide fire sp. Milan teams move to flank protection tasks.

Coy 2IC moves fwd and reports progress on BG net.

5. **Engrs.** Follow up to rear of BG, as coord by Main HQ. Deploy as required.

6. **Recce.** Observe flanks or continue adv as ordered.

Figure 3-H Phase 3 - The Attack

39. **Armed Helicopters and Close Air Support.** By the time that a serious breach or a breakout has been achieved the enemy's air defence radars may have been destroyed, captured or forced to withdraw, leaving a gap in his air defences. This gap may be exploited to route close air support aircraft and armed/attack helicopters into positions from which they can attack the enemy even more effectively.
40. **Bypassing Policy.** It often pays to bypass stubborn enemy opposition and the open desert provides better opportunities than most environments, apart from the constraints imposed by artificial obstacles. However, bypassing requires room, not only for manoeuvre, but sufficient space to deploy a formation emerging from an enemy obstacle system. The commander will determine the policy for bypassing and indicate, probably with reference to phase lines, where, initially, enemy positions have to be reduced, later they may be bypassed after reference to him and, later still, avoided at discretion, provided that their location and strength are reported.
41. **Exploitation.** As the enemy position is loosened up, his armour defeated and his air defences dislocated, the enemy forces may be broken up, encircled and destroyed. This will be the moment to launch a relentless pursuit. The main restrictions will be imposed by traffic congestion in the gaps, especially if formations are passed through each other in forward passage of lines operations, and resupply considerations. Provided a good traffic control system has been set up and the transport lift priority switched from ammunition to fuel at the right moment the pursuit stands a good chance of success. Both have to be planned for well in advance. One of the main problems will be fatigue. The commander may have kept a formation in reserve for the pursuit or have been able to rest, replenish, and reorganize a formation used in the initial assault. Even so, the effort of moving up to, through and out of the gaps means that even a rested reserve will start the pursuit not entirely fresh. The pursuing formations have to leapfrog their own air defence system to provide continuous cover. Reinforcement from force level air defence reserves will be needed to protect an ever extending line of advance.

SECTION 4 -THE MOBILE OFFENSIVE BATTLE

General

42. The commander of a force which is superior in armour to the enemy will seek to bring him to battle in the open where he can be destroyed at less cost than in an attack on a prepared position. Even with an inferior force a skilful commander may be able to beat a larger force by a combination of surprise, deception, speed, achieving as effective a concentration of force as possible and clever use of ground. The commander's aim will be to outmanoeuvre the enemy, catch him off balance, thrusting deeply to prise him out of any defensive positions without an expensive engagement and seize a bottleneck in the enemy's rear. Cut off from his base and logistic support the enemy may be enticed into a counter-attack at a disadvantage. The enemy will be faced with the choice of fighting to a finish or surrendering. In a bare open desert plain where there are no bottlenecks the force on force engagement will consist of fire to pin the enemy down, manoeuvre to hold and surround him and a combination of both to destroy him. Armour will play the leading role, supported by armoured infantry, concentrated artillery and sufficient engineers to deal with any mines and minor

obstacles. Provided that good liaison exists between ground and air forces the latter should be able to intervene with good effect against an enemy in the open, especially when he is obliged to make a major move in reaction to initiatives, provided that his air defence system can be disrupted and degraded.

43. The least expensive way of defeating the enemy is by destroying his main armoured forces in a mobile battle in the open desert. Once this has been accomplished the enemy commander is left with the choice of flight or annihilation. This may be achieved without the deliberate breakthrough battle just described when one or both the enemy's flanks are 'in the air' or during a pursuit. Only the former case is considered in this Section. The latter is discussed in Section 7. The main features of a mobile offensive battle are those of obtaining good information, keeping balance between troops for use and troops in reserve and knocking the enemy off balance in the battle with a concentration of fire.

Preparation

44. Much of the preparatory work will be similar to that for a deliberate attack. The main differences are highlighted below:
 - a. *The Time Factor.* The need to be able to act quickly to take advantage of opportunities presented.
 - b. *Rapid Reconnaissance.* The ability to quickly check or double-check information provided to ensure that tactical possibilities actually exist. This may need rapid redirection of surveillance cover, particularly the use of helicopter reconnaissance to verify information.
 - c. *Concentration of Force.* The capability to have forces reorganised and deployed to take the benefit of any tactical opportunities quickly and effectively.
45. In addition to these requirements the commander will need to plan ahead to break the enemy's decision-action cycle by use of speed and subterfuge. It will probably be necessary to mislead the enemy as to the intended target in order to achieve surprise. Greater reliance may need to be placed on the use of feints such as simulate activity in one particular area or distracting the enemy's attention in another area.
46. In this process of rapid activity simple plans and sound common sense procedures will aid the rapid coordination of plans. Commanders will need no reminding that in rapid and frenetic activity the safety of troops remains paramount. One part of this is to ensure that fatigue does not cut across or inhibit operational activity. The commitment of troops for battle in rotation is a well tried system to alleviate fatigue.

Execution

47. ***Concentration and Speed.***
 - a. Except for sufficient troops to hold the enemy frontally and to launch the feint and subsidiary attacks, the bulk of the armour should be kept together for the main

outflanking move and the decisive armoured battle which will follow. This does not mean that the main force should use just one route. As many parallel routes should be used as possible both to ease the traffic control, movement and logistic problems and to confuse the enemy's intelligence staff. However, the armour, its supporting armoured or mechanized infantry and artillery should be concentrated for the battle and not frittered away in penny packets.

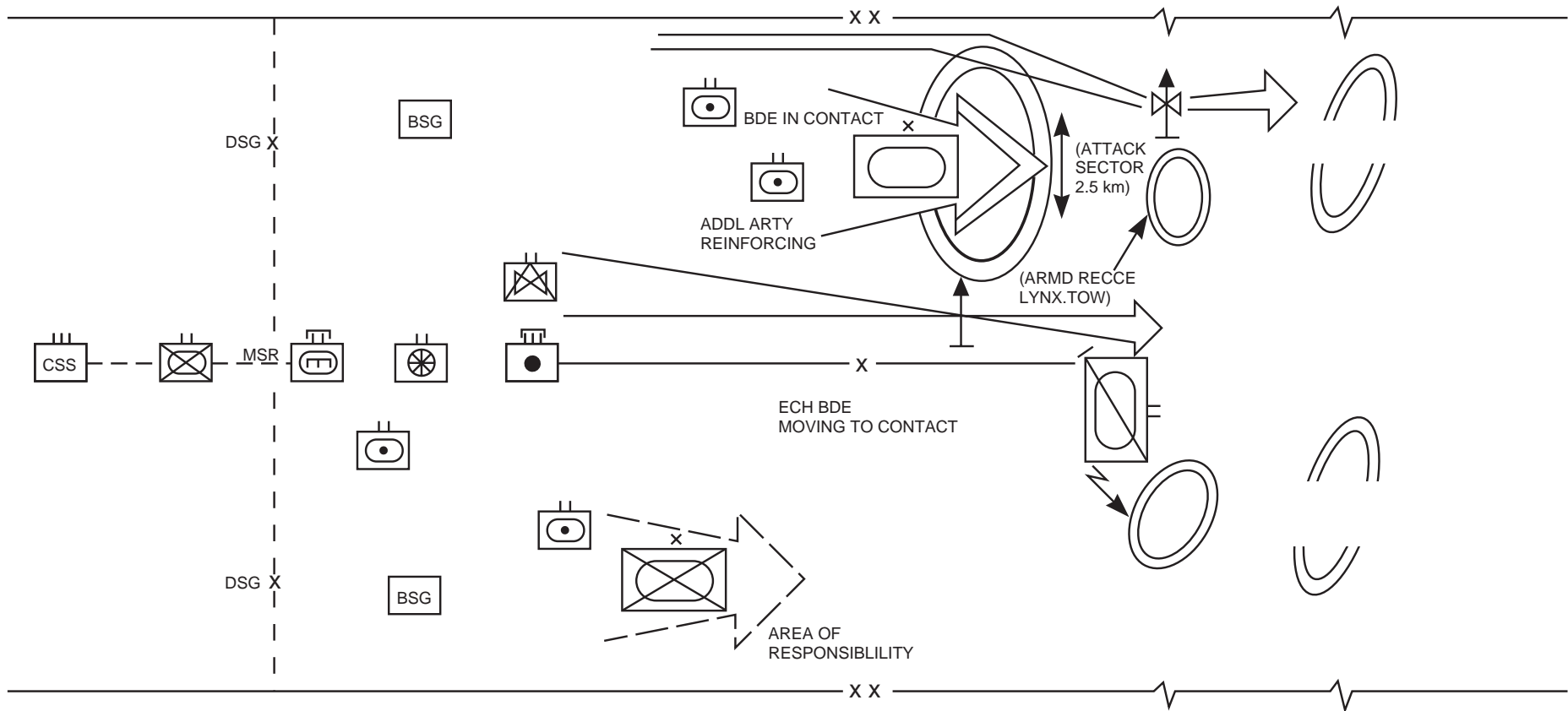
- b. Concentration is not achieved simply by massing formations and battlegroups, which may only provide the enemy with attractive targets, but rather by focusing all the available firepower, artillery, attack helicopters and offensive air in support of each manoeuvre group, eg, an armoured brigade, in turn to win the fire fight quickly. The sequential commitment of manoeuvre groups has the added advantage that each one can be replenished once it has secured its objective. The concentration of fire support and CSS effort on manoeuvre groups sequentially helps to maintain the momentum of the attack. Manoeuvre groups should be given objectives which are well within their capacity in order to keep up the tempo as well as to minimize casualties.
- c. If the enemy has been able to extend his field defences and obstacles far into the desert a preliminary breaching operation may be necessary for a flank attack. If not, armour will lead with reconnaissance elements well out in front until contact is made. Armoured or mechanized infantry will follow a bound behind, ready to consolidate ground won by the armour or to assault a feature together with the armour. The commander will select a few promising axes with the aim of going in deep. While he will designate an axis of main effort he should be prepared to shift it to exploit a promising thrust line rather than reinforce failure.
- d. The force should be shielded by covering troops and possible approaches the enemy might use for a counterstroke should be watched by air reconnaissance, electronic surveillance and long range patrols.
- e. Should the enemy attempt a counterstroke while our forces are on the move round his flank, ground should be selected where some of our armour can be deployed to engage the enemy from hull-down positions while others take him in flank. Attack helicopters provide a reserve of anti-tank firepower which can be switched quickly to a threatened sector.
- f. Speed will aid concentration by seizing and keeping the initiative to oblige the enemy to react to our moves, always a step behind. Speed is not merely a question of covering ground as fast as possible. It involves good battle procedures and SOPs to facilitate the issue of orders and quick deployment when contact is made, previous reconnaissance to avoid bad going, engineer resources to maintain tracks, a good traffic control organization to prevent jams and delays, and coordination between the operational and CSS staffs to ensure continuous replenishment as the lines of communication are stretched out across the desert.
- g. The air defence plan must provide for the continuous protection of the force when it is at its most vulnerable during the outflanking move.

48. **Seizure of Key Terrain.** The success of an outflanking move may depend on the seizure of a defile or a bridgehead across an inadequately guarded obstacle in order to get behind the enemy. Alternatively, or in addition, the commander may aim to capture dominating ground in the enemy's rear which he must counter-attack at a disadvantage in the open, up-sun and against a line of hull-down tanks well supported by armoured or mechanized infantry with anti-tank guided weapons. Every resource, artillery, attack helicopters and close air support, should be concentrated for the battle to secure a quick decision. However, in a mobile battle the aim is not so much to seize ground for its own sake but to use it as a means of destroying the enemy. Figure 3-1 provides a diagrammatic illustration of a mobile offensive battle for a formation.
49. **Choice and Capture of Objectives by Attack.** In a manoeuvre battle it pays to avoid the enemy's strength and to exploit his weaknesses. Positions which the enemy has prepared for defence should be outflanked in a mobile battle. The time wasted in bringing up engineer equipment and preparing a breaching operation over minefields will be put to good use by the enemy to regain the initiative. Positions which have not been mined may be captured by quick attacks under the covering fire of as much artillery as possible. The amount of artillery available will determine the number of objectives which can be attacked simultaneously. Usually, it will be advisable to concentrate the available firepower on objectives sequentially rather than spread the fire too thinly to be effective. Objectives not protected by minefields should be attacked under covering fire from tanks giving intimate support from hull-down positions as well as artillery. Infantry mounted in IFVs or APCs should accompany the leading tanks on to the objective, dismounting on the heels of the artillery bombardment to clear the position while the enemy is still shaken and blinded by the dust from the shellfire. IFVs should help to thicken up the fire of the assault wave tanks.
50. **Encirclement.** Surrounding and destroying the enemy on the battlefield is as old as Hannibal's success at Cannae. The establishment of a ring of forces round the enemy in the open desert is virtually impossible. The cordon would be so attenuated that the enemy could break out either *en masse* in a concentrated drive at a weak point or exfiltrate its mobile troops out in small groups. The best chance of cutting off and surrounding an enemy force is to use a natural feature which constitutes a major obstacle. It is then only necessary to block the main exits where sufficient forces can be concentrated to thwart a break-out.

SECTION 5 - THE ADVANCE TO CONTACT

A Balance of Risks

51. Against an undefeated foe an advance should be undertaken with boldness tempered with a degree of wariness and circumspection. Although the desert offers less cover than most other types of terrain an artful opponent may spring a surprise. The commander of the leading elements advancing out of contact should keep a watchful eye for ambushes and attacks from seemingly unlikely directions without falling a victim to undue caution. Once contact has been made the advance will necessarily be slower but every chance should be taken of exploiting gaps and fleeting opportunities.



NOTES:

1. The aim is to concentrate the formation resources in support of one brigade on only one point of main effort in any one phase. The decision to commit the second brigade following in echelon is dependent on the imminent success of the brigade in contact.

2. Medium reconnaissance forms part of the artillery group which directed air support and depth artillery fire.

3. Unusual abbreviations not explained on diagram:

- AARTY GP Administration, Artillery Group
- ADG Armoured Delivery Group
- AGAA Artillery Group Administrative Area
- BSG Brigade Support Group
- MSR Main Supply Route
- RDBG Route Development Battle Group

Figure 3-I Armoured Formation Mobile Offensive Battle

Organization of Forces

52. As for other theatres the forces will probably be organized into:
- a. Reconnaissance regiments, probably under command of the leading formation, augmented by aviation, supported by artillery and accompanied by FACs. In the desert especially a reconnaissance regiment should move ahead of its main body as far as possible to obtain specific information to fill gaps in the information provided by JSTARS, satellites and air reconnaissance in time for the commander to make and revise his plan and to deploy the forces. The main factors limiting the regiment's ability to range forward will be its vulnerability to direct fire weapons and the ready availability of fire support. If dependent mainly on artillery the interval may be limited to 20 kilometres but in a favourable air situation when close air support can be relied upon or when attack helicopters have reasonable freedom of movement the distance may be extended to between 30 and 50 kilometres. Even so, medium reconnaissance will operate discreetly by stealth. A further limiting factor is the communications link because reconnaissance vehicles have to operate within the range of their radios. Formation headquarters need to be aware to a possible need to provide extra step-ups.
 - b. Leading formations, split into leading and depth battle groups, which are well balanced in order to be able to deal with opposition.
 - c. Reserve formations.
 - d. Flank protection based on armoured reconnaissance regiments, reinforced with helicopters and perhaps supported by a formation capable of parrying an enemy flanking movement. When insufficient armoured reconnaissance is available to watch a flank armoured infantry vehicles may be used.
 - e. Air reconnaissance to be organized in depth and on the flanks to obtain early information on the enemy's positions, movements, traffic and logistic patterns from which his intentions may be deduced in conjunction with electronic surveillance, satellite coverage and other intelligence. If the air situation permits and their presence will not betray a move intended to surprise the enemy, Army aviation helicopters operating in conjunction with the leading reconnaissance elements may give timely warning of enemy positions or mobile forces which are just beyond the horizon of the leading ground elements.

Control

53. The leading group will be given general axes of advance and successive objectives to secure with orders to consolidate on them or to press on. Report lines will be drawn on the map, if possible along readily recognizable features, to keep higher headquarters in touch with progress. Boundaries will be laid down to prevent mutual interference between formations and units and to ensure that the ground is searched for enemy who might have been left behind to harass our supply routes. As the situation can change quickly in the desert, presenting fleeting opportunities and sudden threats, boundaries should not be regarded as inviolable. When a formation

finds it necessary to cross a boundary, its neighbour and higher headquarters have to be informed to prevent fratricidal clashes. Figures 3-J to 3-K give diagrammatic illustration of formation and unit advance to contact layouts.

Conduct of the Advance

54. ***Advance on a Broad Front.*** The advance should be carried out on as broad a front as possible, consistent with the ability to concentrate quickly to meet a sudden threat or produce sufficient strength to deal with all but major opposition. Axes should follow known good going. Areas of fast going from which an enemy surprise may materialize should be watched. The reconnaissance troops should pass information back on terrain, going, obstacles and practicable routes as well as the enemy so that the leading formations may avoid becoming stuck in soft sand and sebkha or reduced to a slow and damaging crawl over rough ground and sharp rock. An advance on a broad front keeps the force better balanced, facilitates rapid deployment and allows formations to provide quicker support for their neighbours than moving in just one column. It also opens up a choice of axes which might be exploited and keeps the enemy guessing as to where the principal effort is likely to be made. The main road or track is an obvious axis because sooner or later it must be opened up for the force's maintenance. However, less well known routes may provide quicker results.
55. ***Bypassing Opposition.*** When opposition is met a quick decision is needed as to whether the leading battle group should stop to deal with it or bypass it, leaving the capture of the position to a depth force. The latter policy may offer a better chance of keeping up the momentum of the advance. The problem, especially in the desert where it is difficult to locate accurately and point out the extent of an enemy position, is to identify the enemy defences, including ditches and minefields, to the depth troops who have to deal with them. Either elements of the reconnaissance force, which first encountered it and whose knowledge is probably accurate, or the leading battle group have to be left behind to mask it, continue observation and reconnaissance and brief the commander of the force detailed to clear it. In order to be able to make an Estimate and a timely decision commanders should keep well forward, moving from step-up to step-up by helicopter. Rebroadcast stations have to be placed sufficiently high up in the order of march to keep their formations and units in touch with their headquarters. This applies particularly to medium reconnaissance which operates further forward and to the flanks in a desert advance. Communications reconnaissance parties should move even further forward to find suitable sites for step-ups and headquarters. A commander who bypasses an enemy position must take care to warn his echelons, notify a safe route which they can use to rejoin and provide for their protection.
56. ***Obstacle Reconnaissance, Clearance and Traffic Control.*** To ascertain the nature and the extent of an obstacle, in order to determine the effort required to clear it, engineer reconnaissance parties and mobility support elements must be well up in the leading battle group. While the desert offers opportunities for outflanking obstacles, hard-topped roads must be opened as soon as possible for resupply. Routes round obstacles, or along gaps through them, must be clearly marked, especially when the ground is featureless. This means that provost should be considered for inclusion in the leading battle groups although this may not always be appropriate. Once breakthrough has occurred provost groups should mark the route for follow-on forces.

ARMoured INFANTRY - HEAVY BRIGADE

1. To remain within artillery cover. Divisional medium reconnaissance, possibly including engineer reconnaissance, will not move more than 20 kms ahead of the main body. If CAS is available it may range 30 to 50 kms ahead. Flanks secured by medium or close reconnaissance or Milan contact turret Spartan.
2. Advanced guard close reconnaissance, possibly including engineer reconnaissance, FAC and FOO.
3. Advanced guard battle group includes OC armoured engineer squadron. An armoured troop will be in support of each battle group.
4. Battle group echelons advance on best route for wheels carrying 3 days combat supplies.
5. Brigade HQ (Forward) travels behind leading battlegroup.
6. Battle group on right flank in echelon at this stage but prepared to pass through leading battle group or widen brigade frontage.
7. *Artillery Group.* Artillery echelon with approximately 1.5 SPG on wheels. Artillery CO with Brigade HQ (Forward).
8. Brigade HQ (Main).
9. Reserve battle group.
10. Engineer regiment HQ and field squadron. CO with Brigade HQ (Forward).

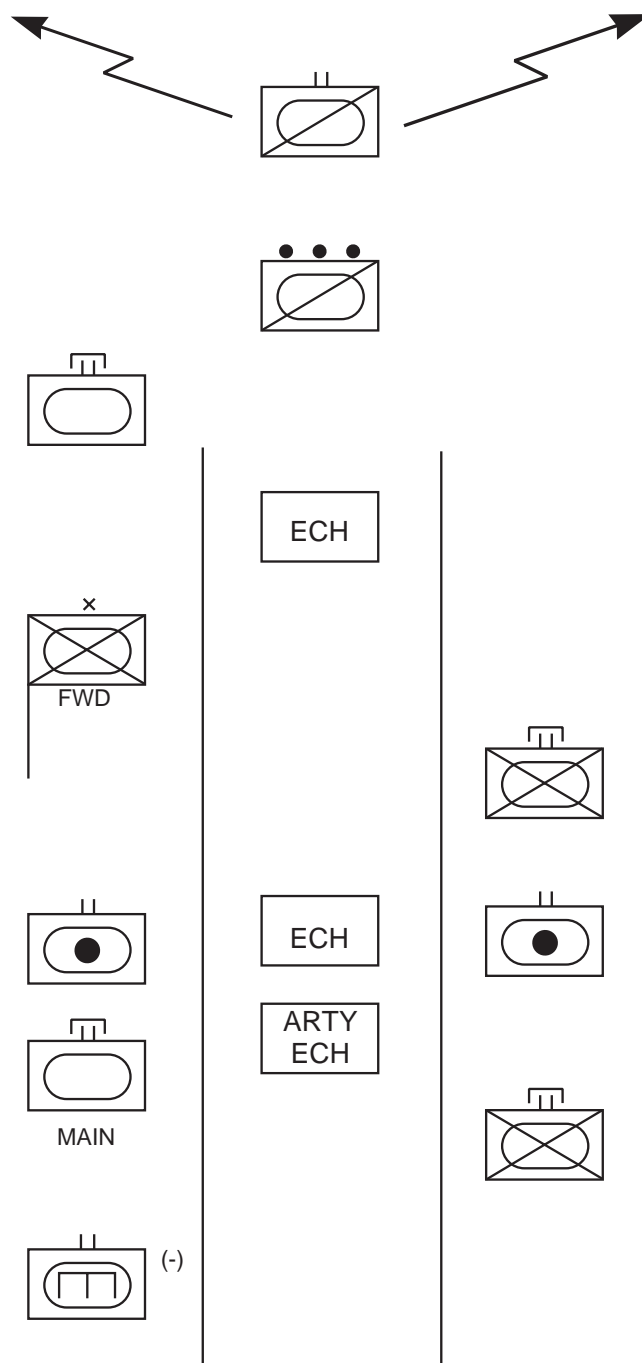
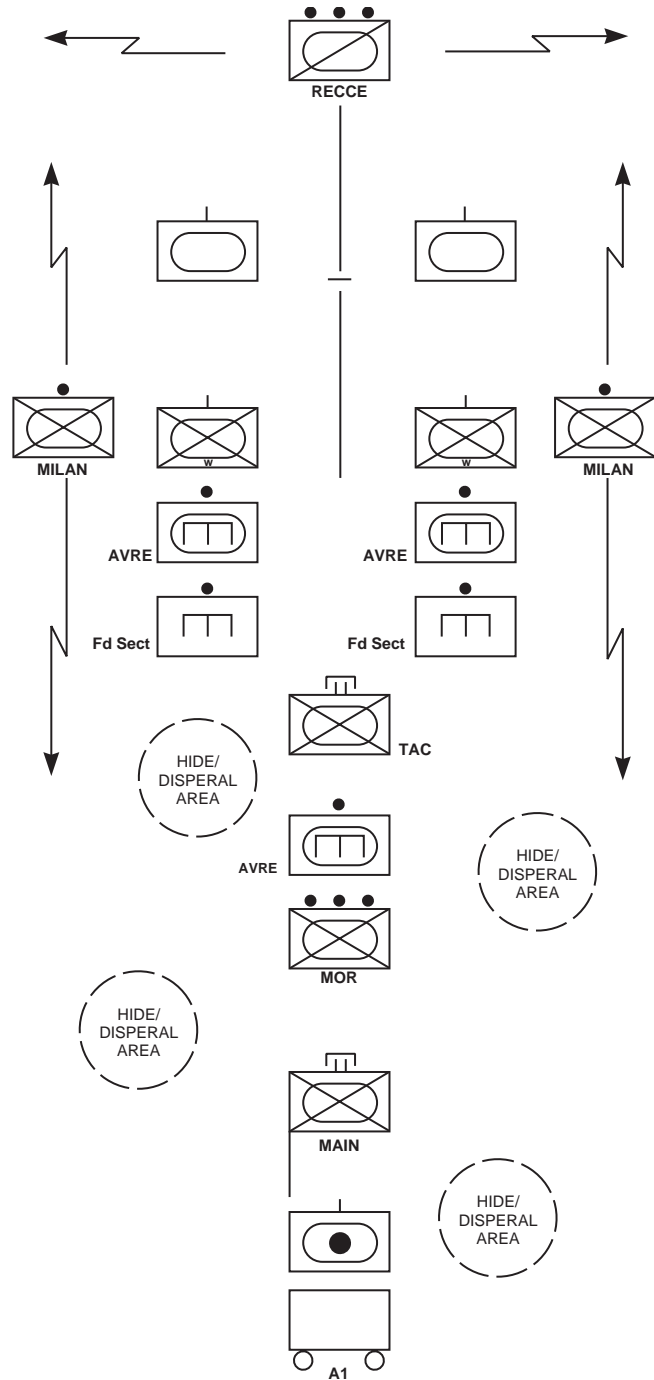


Figure 3-J Advance to Contact - Formation Level

1. **BG Layout - Two Axes.**

- a. *Recce Elms.* #Recce PI, engr recce (fd and armd), MFC/FOO, hel (if tasked), mob Milan (if tasked). Prove routes, ident hides/dispersal areas on orders.
- b. *Sqn/Coy Gps.* To include AVRE and fd sect gp with sqn/coy gp for mov and tasking. Ground will dictate which leads.
- c. *Flank Protection.* Sqns to be prep to deploy one tp as flank protection on orders. Mob Milan/coy Milan dets deploy on orders and hel tasked (if allotted).
- d. *Tac.* Call sign 11B, BC, engr tp comds, AVLB gp under comd for mov.
- e. *Mors.* Deploy immediately on contact. May have to mov fwd into range. Mov along two routes by bounds.
- f. *BG Main HQ.* To mov fwd by bounds with Altn. Coord mov.
- g. *Arty.* Mov coord by BC.
- h. *A1 Ech.* Mov along routes as ordered, using hides/dispersal areas. RAP to gp with A1 Ech.



2. **Hides/Dispersal Areas.** Recce to ident hides/dispersal areas and clear on orders. Rear elms mov at best speed between hides/dispersal areas. Cam and def of hide/dispersal areas in accordance with BG SOPs. Avoid bunching. Mov coord by BG Main HQ.

3. **Single Axis Variation.** Lead sqn/coy gp will fix en posn whilst fol up sqn/coy gp assists it or bypasses on orders. Recce PI fixes en posn, reports, hands over to lead sqn and then presses on. BG Tac HQ sited between sqn/coy gps.

Figure 3-K Advance to Contact - Battlegroup Level

57. **Fire Support.** In the interests of speed of reaction it may be expedient to decentralize the control of artillery from corps to divisions in the advance. Artillery may be leapfrogged forward so that there are always some guns available to give quick indirect fire support or it may move with its formation ready to deploy into action off the line of march. The pace of the operation may be dictated by the less agile guns. FOOs with the leading squadron/company groups and reconnaissance troops may be augmented by helicopter-borne FOOs who can move rapidly to control shoots right across the front. Similarly, attack helicopters can provide a concentration of fire on enemy armour from the most advantageous positions. Both may help to deal with an enemy position or threat quicker than ground-based OPs and anti-tank guided weapons, so maintaining the momentum of the advance.
58. **Close Air Support.** Ground attack aircraft may provide quick and useful support until the enemy main position is reached when a pause may be required to deal with the hostile air defence system. Tight control and positive clearance of close air support will be necessary. In addition, control lines may provide a useful framework. FACs will be needed to brief and talk the pilots on to targets when there are few landmarks. Means, such as venetian blind fluorescent coloured panels, which can remain closed when enemy air attack threatens, must be used to identify our forward troops to friendly aircraft without giving away their positions. When we have air superiority fluorescent markers may be displayed continuously to avoid attack by friendly air forces.
59. **Daylight Movement.** With good observation terrain the leading battle groups should not move too closely behind the reconnaissance troops or they may be pinned down by artillery fire, reducing their ability to manoeuvre when the screen makes contact. Within a battle group the tanks will normally lead with the armoured or mechanized infantry following a bound behind with their anti-tank guided weapons. In very flat terrain where there is virtually no cover armoured reconnaissance units may not be able to use stealth to feel out the enemy. Indeed they prove vulnerable to effective long range fire to which they cannot reply. In such circumstances armour should lead.
60. **Night Movement.** On a bright moonlit night driving without aids is almost as easy as it is by day but the chances of running into an ambush are greater. If the leading reconnaissance elements are thought to be nearing an enemy position they should move by bounds and arrange for other elements to exploit an axis avoiding the position. On a starlit night movement is still possible but because driving and night vision aids have a restricted field of vision the advance will necessarily be slower. On a cloudy, pitch-black night movement without aids is so slow and difficult over all but the best of going as to be barely worth the trouble. However, a combination of satellite navigation systems (GPS) and night driving aids (TI) have created a revolution in night movement. Now it is possible to achieve surprise and shock by exploiting the ability to make a long night move with sufficient accuracy to launch a sudden attack from an unexpected direction. Surprise may be more difficult to achieve if the enemy has a sophisticated long range surveillance system. It will then be necessary to find ways to destroy, degrade or spoof the enemy's system with a good deception plan.
61. **Air Defence.** While air force will attempt to win the air superiority battle, a SAM area defence system must be established over troops and their supply routes as they

advance and a point defence system deployed to cover defiles, gun areas and troop concentrations.

62. **Traffic Control.** Routes, tarmac or dirt, must be kept clear for wheeled traffic. Units not actually using a road or track should move off it when they halt. Apart from keeping routes open for vital supplies this measure reduces the threat from enemy air and missiles. Separate track routes should be signed and patrolled by provost or regimental police, as appropriate, to prevent wheeled routes being churned up. Where possible, provost and regimental police should establish one-way route systems to avoid congestion.

Action on Encountering a Well Defended Position

63. **Action On Contact.** Armoured, engineer and discreet helicopter reconnaissance will establish the general line of the enemy's defensive position, locate obstacles and minefields, draw fire to establish his defensive fire plan and weapon locations and search for gaps or possible routes round his position. The air force will be requested to reconnoitre the position, in depth and provide air photographs. The latter will be particularly useful in a badly mapped country as an aid to navigation as well as for locating enemy positions and obstacles.
64. **Action by Leading Formation.** After appraising the situation, and perhaps undertaking reconnaissance by fire, the leading commander will decide whether or not he has the resources to tackle the position. If he cannot take it or bypass it he will inform his superior and prepare his group to act as a fire base.
65. **Action by Force Commander.** If he appreciates that only a major attack will dislodge the enemy the force commander will make the necessary reconnaissances and preparations for a deliberate attack.

SECTION 6 - THE MEETING ENGAGEMENT

Circumstances

66. **The Intelligence Problem.** In theory, meeting engagements, when a moving force bumps unexpectedly into the enemy, or vice versa, should not occur in such open terrain. Nevertheless, they have been a recurring feature of desert warfare in the past and are likely to remain so. This is not merely because of the vastness of empty space and gaps in the surveillance coverage. Pictures gained by satellite, drone and air photography, supplemented by visual reconnaissance may produce a confusing picture of a mobile desert battle. Despite the best efforts to anticipate threats and to obtain and disseminate information and intelligence, there are bound to be surprises. Enemy mobile troops can cover ground quicker than anticipated over good going, erupt suddenly from a supposedly impassable area over a hidden route which has not been watched, emerge unexpectedly from behind rising ground or from the concealment of a wadi to take our troops and their commanders unawares.

67. **High Risk Times.** The most dangerous times are:
- a. In the middle of the day when heat haze and mirage restrict visibility and reduce warning time.
 - b. In the morning and evening when an enemy may approach down-sun unnoticed and hold the light advantage. Similarly, an enemy may approach unheard against a strong wind.
 - c. During a sandstorm, not severe enough to stop movement but which reduces visibility and is sufficiently uncomfortable to induce troops to cover up and relax their vigilance. The enemy may deliberately use a duststorm to obtain surprise. Alternatively, two forces might collide by mistake in such a dust storm.
 - d. At night, when the wind usually drops, engines and tracks can be heard a long way off. However, surprise can be achieved in the dark when:
 - (1) The sound of battle elsewhere drowns out the noise of approaching enemy armour, IFVs and APCs.
 - (2) Enemy infantry dismount well away from their objective and approach silently on foot from an unexpected direction making good use of the contours to avoid surveillance.

Precautions and Remedies

68. **Vigilance.** Only constant vigilance can guard against the chaos caused by a sudden enemy irruption. Reconnaissance screens have to be pushed further out in the desert to alert troops and to give commanders sufficient time to react. Surveillance must be maintained at all points of the compass in the open desert.
69. **Balance.** Because the risk of a meeting engagement is particularly high in the desert, units and formations should always move in a balanced tactical formation with anti-tank and air defence weapons able to go quickly into action. The force should move in such a way that whichever element makes first contact with the enemy it can deploy rapidly to take up a defensive position which can be used as a fire base and a pivot of manoeuvre for the main body.
70. **Anticipation.** If, during a long move, there is any chance that the enemy might attack during a halt, troops should take up defensive positions rather than go into open or close leaguer. During a move, commanders at all levels should anticipate the unexpected and constantly examine the ground with a view to assessing risks and noting any key terrain which he should aim to seize and hold if the enemy is suddenly encountered. Diagrammatic examples of a meeting engagement are given in Figures 3-L to 3-N.
71. **Radio Silence.** Although ideally surprise desert moves should be conducted in radio silence the problems of moving large formations requires some means of quick and universal control. Such moves are, therefore, usually made on 'radio minimise'. To

1. Medium reconnaissance identifies presence of enemy and provides early, delay and attrition, supported by artillery, aviation and CAS.

2. Close reconnaissance takes up identification of enemy axis and strength. Imposes delay with artillery and also aviation, if available.

3. Advanced guard battle group deploys company/squadron group as guard force. Close reconnaissance provides flank guard assisted by medium reconnaissance and/or aviation, if available.

4. Advanced guard battle group adopts a delaying posture with two armoured squadrons up, allowing a rolling withdrawal to maximise the firepower and protective capability of the MBT. Battle group trades space for time in order to inflict significant delay and casualties on enemy.

5. Formation HQ (Forward) may move to join advanced guard battle group.

6. Remainder of formation deploys to positions that allow rapid and effective implementation of counter-moves. This may involve use of false fronts and minefields.

7. Advanced guard battle group withdraws into brigade reserve positions and prepares to take part in formation counter-moves.

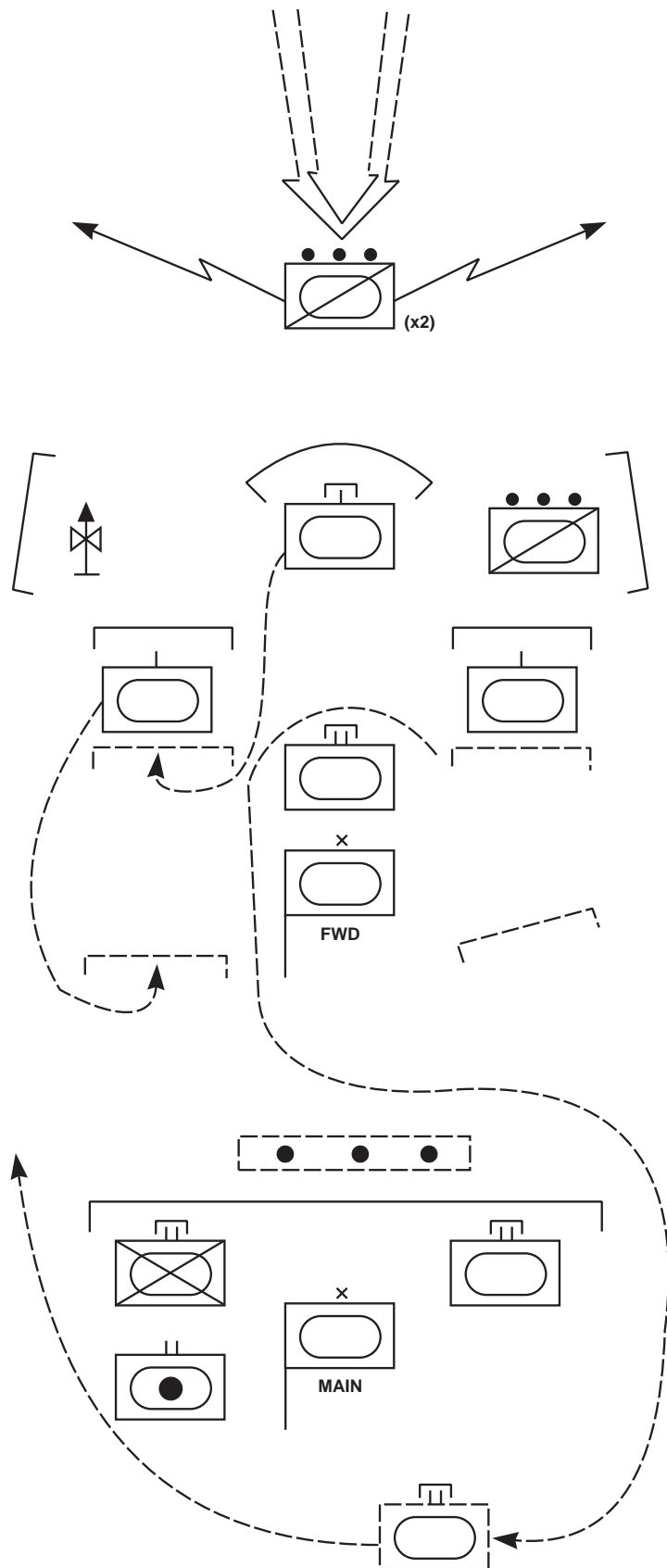


Figure 3-L Meeting Engagement for an Armoured Formation

1. Close reconnaissance group (one or more troops) identifies enemy axis and strength. Imposes delay with artillery and also aviation, if available.

2. Close reconnaissance moves to cover flanks when required.

3. Advanced guard battle group deploys company/squadron group as guard force.

4. Advanced guard battle group adopts counter penetration posture designed to maximise its firepower and to exploit the protective advantages of the MBT:

- a. K - kill potential against enemy MBT out to 2,500 m.
- b. Protection against enemy K - kill over 60% frontal arc at 1000 m plus.
- c. Use of TOGs (through dust obscuration and at night).
- d. Exploit speed advantage over slower enemy tanks.

5. Sub-units manoeuvre through series of positions to keep enemy armoured in 'kill zone'. Must also retain ability to turn 'box' against flank manoeuvre. Artillery should be coordinated for obscuration/attrition to allow withdrawal of leading elements as enemy reaches 1000 m point.

6. Advanced guard battle group passes back through main formation positions and prepares for counter-moves or counter-attacks depending upon combat ratios at the time.

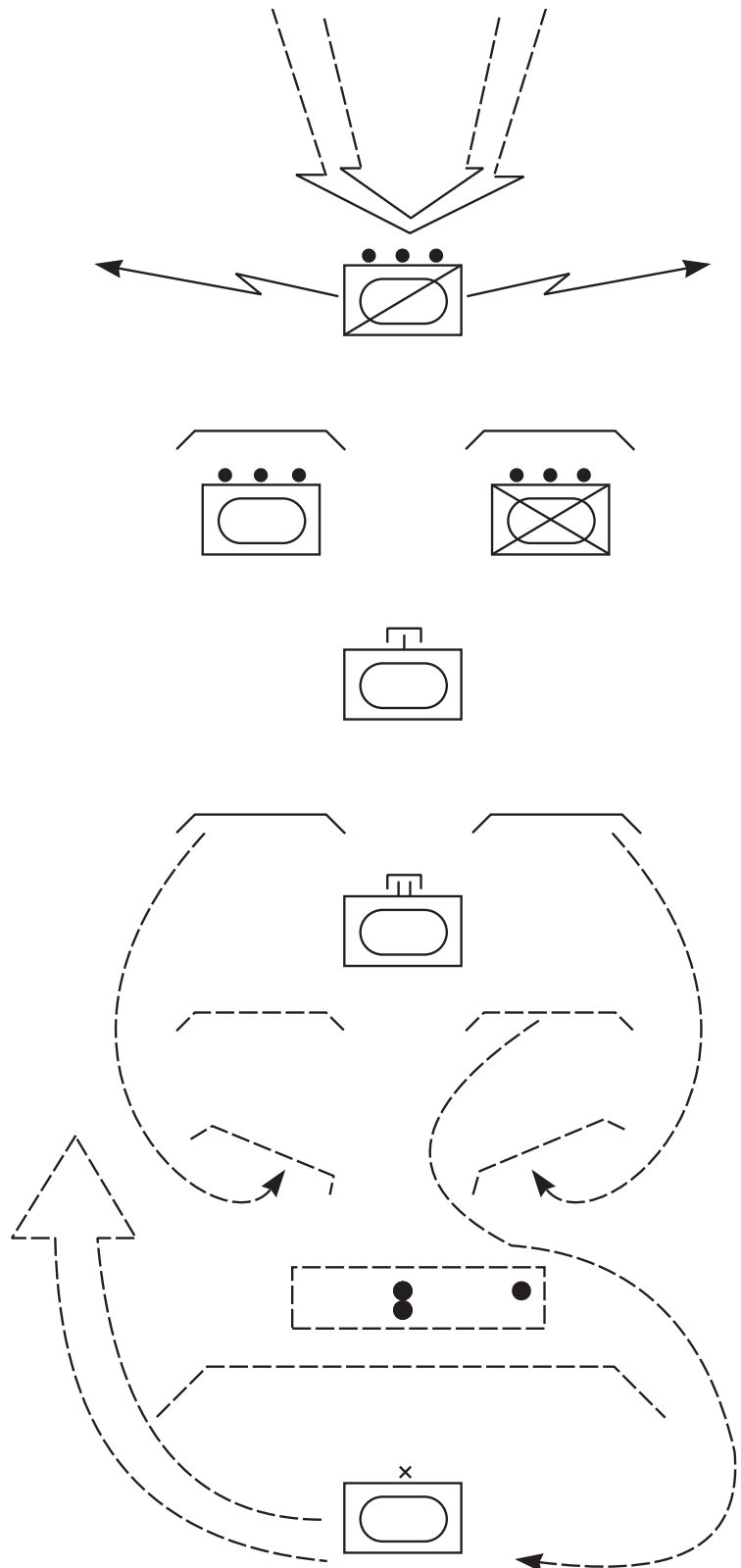


Figure 3-M Meeting Engagement. Advance Guard in Action

1. Medium reconnaissance moves to cover flanks.
2. Advanced guard battle group fixes enemy while close reconnaissance identifies enemy positions, LD, SL, FUPs etc. Engineer reconnaissance assesses engineer tasks.
3. Armoured engineer squadron resources close up for formation operation. Additional engineer resources requested if necessary.
4. Formation HQ (Forward) joins advanced guard battle group HQ.
5. Main body of formation closes up for subsequent operations.
6. Artillery begins adjustment and preparatory bombardment.
7. Engineer regiment (field squadron) elements) prepares to support operations.

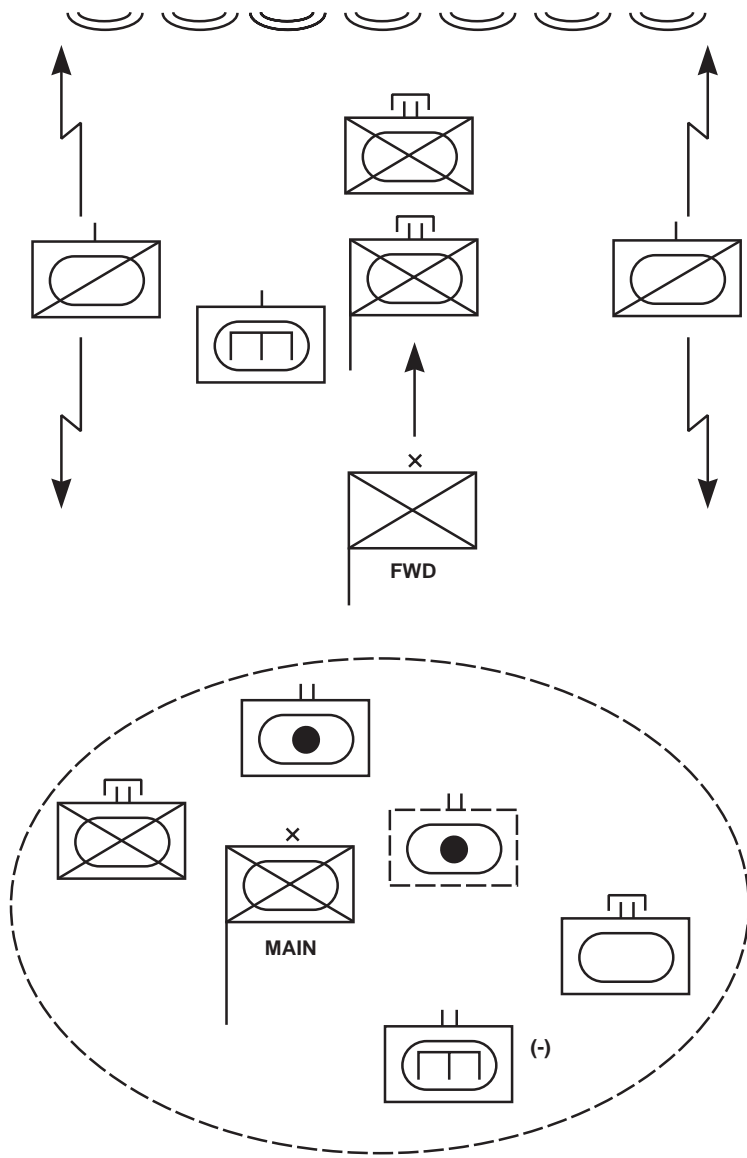


Figure 3-N Meeting Engagement. Bumping the Main Defensive Position

help to reduce the amount of radio traffic, control can be exercised using flag or light signals. If it is both desirable and feasible for small bodies of troops to move under 'radio silence' their radios should always be kept on listening watch so that radio silence may be broken quickly to pass information upwards and orders downwards. The temptation to switch sets off to conserve batteries has to be resisted.

Action on Contact

72. ***Flexibility and the Aim.*** It goes without saying that a commander should always try to carry out the mission given him by his superior. However, he may be obliged to postpone its achievement or even abandon it altogether if he encounters serious opposition from larger forces. Alternatively, if he surprises an enemy force he may appreciate that turning aside to destroy it may further his superior commander's purpose better in the end. In an environment notorious for the sudden appearance of threats from unexpected quarters, even with modern surveillance aids, there will be one less enemy element able to intervene later to thwart the overall plan. Whatever the commander on the spot decides to do he must tell his superior as quickly as possible.
73. ***Decision and Initiative.*** If the efforts a commander makes to secure early warning of the approach or presence of an enemy force pay off he may have time to lay an ambush or prepare an attack. If the meeting is sudden he will have to formulate a plan with scanty information on the spur of the moment. Moving his command post to a position from which he can observe the situation and control the battle may enable him to move inside the enemy commander's assessment, decision and action time cycle and so keep or regain the initiative.
74. ***The Offensive Option.*** If feasible, a commander should opt for offensive action to knock the enemy off balance, keep him off balance and beat him. The initiative is a priceless asset in desert warfare. Commanders must instil a sense of urgency into their subordinates in order to gain and keep the initiative. To win the fire fight quickly and decisively the commander on the spot must concentrate an overwhelming superiority of fire power before the enemy can do likewise. The effect on morale of concentrated fire is even greater than the material damage that it inflicts.
75. ***The Defensive Option.*** Should the commander appreciate that he is up against superior forces which will not succumb to an *attaque brusque* or there is time to organize an ambush he will secure the dominating ground and, in the latter case, conceal his movements. Even if forced on to the defensive by superior forces he may dislocate the enemy's attack with a spoiling attack of his own, launched with the sun in the enemy's eyes and via a covered approach. Every jolt he can administer will delay the enemy, gaining time for reinforcements to arrive and for additional artillery, armed helicopters or close air support to be made available. If the enemy has the initiative minefields may be laid by a combination of mechanical and scatterable systems, preferably in conjunction with a natural obstacle, if there is one, to induce caution and delay to give time for the organization of a fire base and offensive action.

SECTION 7 - THE PURSUIT

The Opportunity

76. The open desert is the ideal terrain in which to exploit a victory and annihilate the enemy. Once he has been knocked off balance in a sharp defeat he must be pursued remorselessly to prevent him from reorganizing. Speed, vigour and boldness can achieve more in a few days of pursuit than in weeks of grinding battle. There are fewer places where a retreating enemy can make a stand in the desert than in European terrain. Every effort should be made to anticipate the enemy by occupying potential defensive positions first or chivvying him out of them before he can organize a coherent defence.
77. Pursuit is the phase of war in the desert where risks should be run. It will not be easy for the enemy to conceal a countermove. Provided air and ground reconnaissance, reinforced by satellite surveillance, are used properly to watch for points of resistance and the concentration of enemy forces, a pursuit can be pressed home more devastatingly than in other types of country.

Planning

78. ***Preparing the Pursuit While Fighting the Battle.*** The pursuit should be part of the plan for an offensive battle, or for a defensive one in which a counterstroke is envisaged to inflict a crushing riposte. As the battle begins to go favourably the outline plans should be adjusted to take advantage of the situation. If possible, fresh troops should be kept in reserve to head a pursuit, or a formation which has been taken out of the line at the end of an earlier phase given the task. If this is not possible, the formations which achieve the breakout or whose counterstroke wins the battle will have to carry out the pursuit themselves. Short of sleep and with little opportunity for the repair and replacement of damaged tanks, vehicles and equipment their men should be told that an extra effort while the enemy is disorganized will achieve results which hard fighting and heavy casualties may be unable to realise a few hours or days later. If passing formations through each other can be avoided there will be a better chance of avoiding the confusion and delay caused by a combination of congestion, clouds of dust and desert tracks whose surface has been ruined by the passage of too many vehicles. Whichever formations are used they must be well balanced so that they can deal with any opposition the enemy may be able to offer. The question of the use of a helicopter-borne force in an airmobile operation or an amphibious landing to seize a key area behind the enemy should be considered.
79. ***Objectives.*** A pursuit operation may aim to seize certain objectives as well as to complete the destruction of the enemy. It will be necessary to stop the pursuit on a line which is naturally defensible. The capture of airfields and a port will be at least as important for us as their denial is to the enemy. Without airfields from which the air force can continue to provide a favourable air situation, in addition to the re-establishment of a ground-based air defence system, our gains may not be tenable. Similarly, ports and airfields which can be opened up to reduce the length of the land

supply route will be essential for the maintenance of the force.

80. **Parallel Pursuit.** Provided that the going is suitable and there is an open flank it may be possible to launch a force in pursuit along an axis parallel with the main road or routes. A parallel pursuit has three advantages. It may turn any intermediate positions, or even a main position, which the enemy is planning to hold. By overhauling the enemy and cutting in behind him it may be possible to isolate a sizeable proportion of the enemy force. Traffic congestion is reduced, enabling formations to move faster and to replenish more easily.
81. **Airmobile and Amphibious Landings.** The opportunity to seize vital ground in rear of the enemy with a force landed by helicopter or from amphibious shipping may present itself. The latter method requires considerable preparation and specially trained troops. Five conditions should be met for such an operation to succeed:
 - a. Air superiority and also naval superiority for an amphibious landing.
 - b. The position selected must be one that the enemy cannot bypass in his retreat.
 - c. The position must be sufficiently broken and rugged to enable a light force with only anti-tank missiles and a rudimentary air defence system to be able to hold it.
 - d. It must be possible for the main force to relieve the helicopter or seaborne landed troops within a few days.
 - e. From the CSS point of view the force must either be self-contained or be capable of being resupplied until relieved.
82. **CSS Planning.** The combat service support of a pursuing force will be all important to enable it to maintain momentum. It may be necessary to ground a formation in order to provide the maintenance lift to support a long pursuit. The CSS plan for the pursuit must be considered when the attack itself is being planned, and not extemporised at the last minute, so that the material effort to support the operation can be identified and provided for. If the resupply aspects of a pursuit are not considered until the success of an attack makes it a feasible option it may be too late to improvise the resources to back it and the fruits of victory may fall from our grasp. CSS units moving up behind the advancing troops must go firm at some stage to provide a service. This may involve leapfrogging CSS installations.
83. **Organization.** Clearing up the battlefield, rounding up prisoners and salvaging equipment should be left to a formation remaining *in situ*, rather than spread out amongst the force, in order to release the maximum number of troops for the pursuit which can be supported logistically. This may be a suitable role for air-portable infantry to spare armoured infantry for their mobile battle role. Traffic control is even more important in a pursuit than in an advance to contact. The confusion at the end of a long battle may delay the exploitation. Guarding and evacuating the numbers of prisoners which may fall into our hands during a pursuit is an even greater problem in the desert than elsewhere because of the ease with which they can slip away in the

dark. Prisoners should be relieved of anything which might assist navigation and they should be allowed to carry only the water bottle (permissible in the Geneva Convention), so that they cannot accumulate sufficient water for a long escape march. Units should be detailed to receive and marshal prisoners, sending them back under escort in returning resupply vehicles, so that the leading troops are not encumbered and delayed by the need to guard them.

Control

84. ***Position of the Commander.*** At all levels commanders must be well forward using the step-up and helicopters mentioned in the discussion of the advance to contact. Careful planning and forethought will be needed to maintain uninterrupted, secure communications.
85. ***Axes and Report Lines.*** These will be required as an instrument of control just as for an advance to contact. However, it may be necessary to change axes of advance to avoid known enemy defensive positions so that they can be outflanked and their defenders faced with the choice of withdrawal or destruction. Reconnaissance units may mark their axes of advance with their formation tactical signs and place distance markers at intervals of one or more kilometres from a known point to help units in the main body to establish their position accurately and to provide a datum point for the control of fire support.

Conduct of the Pursuit

86. ***Balance.*** A pursuit will normally be led by armour, specifically the armoured brigade of an armoured division. Medium reconnaissance regiments may be tasked to move well ahead to verify information provided by satellites and air reconnaissance on gaps which may be exploited and alternative routes. A squadron may also be detailed to watch an exposed flank or to make contact with another formation approaching from another direction to prevent an engagement between friendly forces. Infantry-heavy battle groups to deal with enemy attempting to organize a defensive position in broken ground should follow. Artillery must be leapfrogged to give continuous support and engineer effort will be required for obstacle clearance and route maintenance. Both require adequate reconnaissance parties moving with the forward formation. Mobile air defence missile systems must also keep pace with the forward troops to prevent the enemy from launching a damaging attack to impose sufficient delay on us to allow him to extricate his forces.
87. ***The Fleeting Opportunity.*** The pursuing force will advance on as wide a front and along as many routes as the going and the CSS system will permit. The aim will be to maintain the momentum of the pursuit, breaking up the enemy so that he cannot organize any effective resistance. On meeting a feature where the enemy is attempting a hasty defence the commander of the leading battle group or formation will have to decide whether a quick attack is likely to succeed or whether it should be bypassed. It will often pay to bypass the position, masking it with the minimum forces to fix the enemy and reconnoitre the ground with a view to briefing the follow-up formation or battle group tasked with its clearance. Should the leading formation or battle group commander decide on a quick attack and fail he should reconnoitre the position on a wide front to find a weak sector or an exposed flank. Either may provide a fleeting opportunity for a quick breakthrough or a turning operation to render the

enemy's position untenable and force him to retreat.

88. **Flexibility.** The critical item in mobile operations like a pursuit is flexibility, especially in the desert where the information, decision making and action cycle is shorter than in the closer country of Europe. While the leading troops are searching for a way round opposition the commander must be prepared to switch his main effort from one axis to another or to an entirely different one. This involves thinking ahead to arrange visual and photographic reconnaissance with the air force, to order armoured reconnaissance troops to probe any promising route and to warn formations to change direction in good time before they become committed in a sector where they are unlikely to succeed or become bogged down in bad going. While formal orders have their place in a battle of attrition the more one wishes to manoeuvre to exploit opportunities and to turn potential enemy defensive positions the more the force commander must tell his subordinates the aim of the operation, what he requires them to do and leave them to work out the details. Tactical flexibility has to be matched by CSS flexibility to shift the flow of combat supplies to support a more promising axis.
89. **Boldness.** Allied to flexibility is boldness. In a fluid battle an audacious move may bluff the enemy into precipitate retreat. Although advancing troops are always worried about being exposed suddenly to hostile fire, a beaten enemy is even more concerned about the prospects of being cut off in the desert. Risks may be taken against a beaten enemy which would not be justified in a set-piece attack.
90. **The Pursuer's Dilemma.** Eventually, the leading troops will encounter a better organized position. The problem in the desert is distance. With the emphasis on lifting fuel forward in a pursuit, battle groups will only have their unit mobile stocks of ammunition. The artillery may be seriously short of it unless ammunition convoys have been organized before the pursuit started. Helicopters may be able to lift a useful amount forward but probably not enough to sustain a major attack. The pursuing forces will be tired, their vehicles and equipment showing signs of wear and the CSS system strained to near its limit. Although morale will be buoyed up by success, weary men are less brave and tired commanders less resolute. A delay of a few days to bring up more troops and ammunition, to rest and reorganize the exhausted leading formations and to repair battered equipment may seem prudent. However, it may give an even more ragged enemy time to consolidate. By the time forces are deemed to be ready, the enemy may have withdrawn or the opportunity for a quick, cheap victory may have disappeared and the commander will have to resign himself to another costly battle of attrition. It will be a matter of fine judgment on the part of the force commander as to whether to risk a quick attack or consolidate his gains. Much will depend on the intelligence assessment as to whether or not the enemy has been able to bring up fresh formations and additional logistic resources.
91. **Consolidation.** Inevitably, there will come a stage when a pause is essential. Whatever happens, the pursuit must not be allowed to falter in the open desert or in front of a well-manned position where a weakened force at the end of its logistic tether is vulnerable to a crushing countermove. As the force reaches successive defensible positions the commander and his staff must make realistic decisions as to whether or not it can reach the next one and hold it. If the prospects are unfavourable the commander should halt, consolidate and be able to justify his decision to higher

authority. The pause will enable him to close up his forces, bring forward any formations which have been left behind to clear up the old battlefield and open ports and airfields to rationalize his resupply and repair system. The conduct of the pursuit and the decision to pause can only be made in the light of the situation at the time. Engineer resources will have to be allocated carefully and moved in order to:

- a. Help to protect the open flank or flanks created by a rapid pursuit.
- b. Retain sufficient to consolidate rapidly when required.
- c. Maintain a reserve to cover the unexpected.

CHAPTER 4

DEFENSIVE OPERATIONS

SECTION 1 - INTRODUCTION

Setting

1. The desert itself has no intrinsic value. Although the abandonment of ground may be distasteful from a some points of view military advice should explain that a battle fought on disadvantageous terms purely to save a stretch of empty ground may invite an unnecessary defeat and serious consequences. More essential than the retention of ground is the survival of a mobile, armoured capability. The loss of the mobile reserve makes a defensive position untenable. Trading space for time to reinforce this capability enables a commander to fight a successful battle at a time and place of his choosing with the added advantage of forcing the enemy to fight at the end of an extended supply route. Once the enemy has been defeated, the initiative will have been regained and the lost territory will be recovered. However, a force commander may be obliged to fight a defensive battle rather earlier and further forward than he would like in order to secure some vital asset, such as a base area, an airfield complex, an entry port, an oilfield or an ally's capital. Because deserts favour mobility and offensive action, defence can only be a temporary phase and used to gain or recover the initiative. Defensive battles must be fought as aggressively as possible, taking any opportunity to seek a local advantage before launching a counter-offensive to regain the initiative.
2. A force will only go on to the defensive for one of four reasons:
 - a. It is insufficiently strong to take the offensive. It may already have suffered a defeat and been forced to retreat.
 - b. The two sides have fought themselves to a standstill and take up improvised defensive positions.
 - c. Temporarily, at the end of a rapid advance when a force has become strung out and outrun its artillery support, or for longer if it has outpaced its combat service support, particularly artillery ammunition or fuel, and needs a pause to bring up troops and combat supplies to mount another concentrated blow.
 - d. For political reasons. Our forces, called upon to assist a friendly state threatened with invasion, take up a defensive position.

Aim

3. The aim of a defensive battle in the desert is to reverse an unfavourable operational situation and turn the tables on the enemy by the use of ground, obstacles, fire-power and manoeuvre to dislocate and disrupt his attack in order to pave the way for renewed offensive action. The object of the latter will be the destruction of the hostile forces,

or such a substantial portion of them, that in the best circumstances the enemy will be annihilated or, at least, forced to retreat.

Elements of a Defensive Position

4. **Types of Defence.** Defence in the desert may be:
 - a. *Deliberate.* When there is time to prepare a position free from enemy interference, either before hostilities start or well behind the current battle area in anticipation of a reverse.
 - b. *Hasty.* Improvised in contact with the enemy either after an unsuccessful offensive or at the end of a withdrawal when the enemy is at the end of his resources and is obliged to halt. An example of how an armoured infantry heavy formation might adopt a hasty defensive position is shown diagrammatically in Figure 4-A.
 - c. *Delaying.* A mobile delaying battle may be fought in two circumstances:
 - (1) When there is little space to trade for time in front of some vital asset, like a port of entry, and our forces are at a temporary numerical disadvantage, it may be necessary to fight a delaying action in the open desert on a larger scale than a covering force operation to gain time for the arrival of reinforcements, such a situation may occur at the beginning of a campaign. Any offensive action that can be taken to disrupt the enemy's plans and force him to react rather than pursue his aim will be to advantage. Forces available are likely to be inferior in strength it will be necessary to task intelligence and subordinate commanders to find a vulnerable place in the enemy's dispositions where the limited resources can effect the maximum dislocation and distract the attention of the enemy commander.
 - (2) When the desert terrain is very open and the available forces are numerically weaker than the enemy but not markedly so. There may be good reasons for not withdrawing to the next really good defensive position a considerable distance to the rear. It may be necessary to hold some important locality or installation, and there may be a good chance of success in fighting a defensive battle in considerable depth, based on such minor features and natural obstacles as the terrain offers, reinforced by artificial ones. By trading space for as much time as is consistent with the preservation intact of mobile forces it may be possible to impose sufficient delay for the arrival of reinforcements, or forces reconstituted after a previous reverse, to offer battle on advantageous terms against an enemy whose communications are becoming increasingly attenuated. Ultimate success will depend on our ability to launch a counter-offensive.
5. **Selection of a Defensive Position.** To enable a weaker force to beat a larger and equally efficient one a commander will aim to use favourable ground to redress the imbalance in combat power. Where possible the flanks of a defensive position should be secured by the sea, sebkha, an escarpment, a depression or gebel. Ideally, the

1. Hasty defence only adopted as part of a pause in operations.
2. Medium reconnaissance acts as early warning and guard force, covering likely enemy axis. May be reinforced by tanks or aviation assets.
3. Formation adopts defensive position, matching arcs to the ground and the tactical situation.

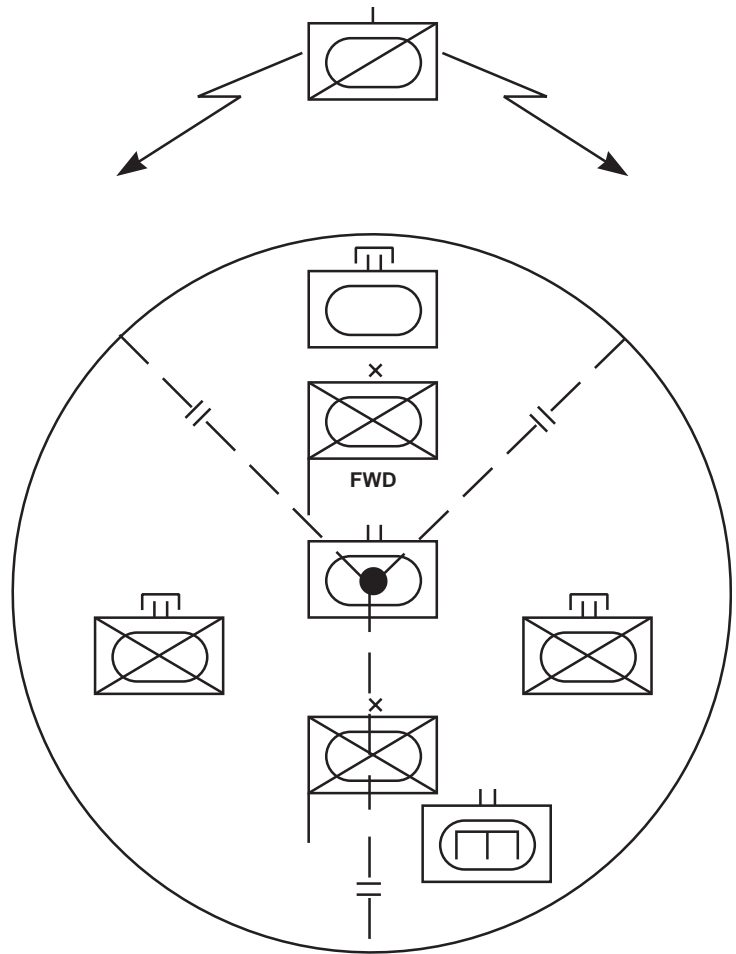


Figure 4-A Hasty Defence. Armoured Infantry Formation

area in which the defensive battle is to be fought should be in broken country, with hill features, sebka and soft sand limiting the number of practicable approaches to canalize enemy movement in the area of the FEBA, and depressions, wadis and scrub to provide some concealment. A network of tracks, natural or constructed, is necessary for the movement of reserves in the rear of the battle area on as many routes as possible.

6. **Components of a Defensive Battle.** As in central Europe a force on the defensive will, ideally, be divided into three components:
 - a. Covering troops.
 - b. Troops occupying the main defensive position.
 - c. Mobile reserves.
7. **Shaping the Battlefield.** The mobile reserves include the main reserve whose role is to deliver the decisive counterstroke and smaller reserves for counter-attack and counter-penetration. The commander will have a design for a defensive battle, a scheme to hold key terrain and to canalize the inevitable enemy penetrations into ground of his own choosing, where he can use his main reserve to defeat a substantial portion of the enemy force and regain the initiative. It will be convenient to discuss the main position and the use of the mobile reserves first, leaving the covering troops to be dealt with later, because their role is subsidiary, to act as an initial shield for the former and to provide information.

SECTION 2 - THE ROLE OF COVERING FORCES

8. **Role.** Covering forces are deployed ahead of the main position, ideally further forward than in the closer terrain of central Europe, to obtain intelligence on enemy dispositions and intentions and to provide warning of the strength and direction of an enemy advance. Because the open desert offers such a wide choice of approaches, covering forces should base their delaying positions on features which provide a continuous barrier to movement with as few gaps as possible, where such obstacle lines exist, so that the enemy may be persuaded to disclose his main axis by the choice of gap or gaps he selects for penetration. While a covering force should be capable of inhibiting enemy reconnaissance and imposing some delay it should not become involved in a defensive battle to hold ground. If it does so it risks destruction or serious casualties. As the covering force may well be required to form part of or even the bulk of the force commander's reserve for the battle on the main position he will be faced with the problem of how much of his force he can afford to commit beyond the FEBA to achieve how much delay when there is a risk that it might be severely mauled in the open desert. Should the time factor be important, to allow the organization of a defensive position, then a much larger force will be required to conduct a fighting withdrawal.
9. **Composition.** The covering force may comprise between a quarter and a third of the total troops available. It will require:

- a. Additional medium armoured reconnaissance troops to watch the large front-ages and any vulnerable open flank or flanks in the desert.
 - b. Armed/attack helicopters to provide a mobile reserve of anti-tank firepower which can be concentrated quickly and in sufficient strength at threatened points.
 - c. SP medium artillery and MLRS to provide sufficient range to cover wide arcs and to engage approaching enemy columns as far out as possible.
 - d. An extension of the main position's air defence system to provide cover, at least initially, in considerable depth.
 - e. Access to a surveillance system, eg, JSTARS.
10. **Ad-Hoc Forces.** A commander whose armour has been beaten and depleted is faced with the problem of providing an adequate reserve of armour for the main body, let alone a well balanced covering force. He may be reduced to the expedient of deploying rather more of his artillery forward than he would have wished, shielded by armoured reconnaissance units and ATGW, supported by reconnaissance and attack helicopters and backed by as much armour as he can spare, in order to obtain information, provide security and gain time. Such shifts should be abandoned in favour of more orthodox tactics as soon as his armoured force has recovered sufficiently. In such circumstances attack helicopters will assume an even greater importance in countering the enemy tank threat.
11. **Command.** Because the covering force is likely to start operations further ahead of the main defensive position than in European terrain it may be better to use a formation headquarters to command the whole operation over the entire front. The alternative, delegating command to each major formation in its own sector, would involve serious coordination problems and too many headquarters, better used organizing the main position.
12. **Organization.** The covering force comprises three elements:
- a. **Screen.** Reconnaissance troops, including anti-tank guided weapons, supported by artillery, including anti-aircraft, reconnaissance and armed helicopters to provide surveillance and observation right across the front and any exposed flank.
 - b. **Delaying Forces.** Armour, with some armoured or mechanized infantry for close protection, particularly at night, together with anti-tank weapons, supporting artillery, medium as well as anti-aircraft, and attack helicopters capable of offering sufficient resistance to cause some delay and force the enemy to show his hand.
 - c. **Local Reserves.** Forces strong in armour, with some armoured or mechanized infantry, supported as in sub-paras a and b above, which can call on concentrated artillery support to:

- (1) Hold up enemy penetrations.
 - (2) Spring ambushes from the flanks of enemy thrusts.
 - (3) Help to extract troops of the two other elements which are in danger of being pinned down or overrun.
13. **Preparation.** The amount of engineer work and deception which can be undertaken will depend upon the time available. If called in to assist an ally during a period of tension there may be time to lay antitank minefields, create phoney ones and crater gaps through escarpments. Similarly, at the end of a long withdrawal the enemy may need time to assemble his forces and build up stocks of ammunition and fuel, time which we can put to good use. The corollary is that the enemy will also have time to reconnoitre dispositions and to find out how the defensive battle is to be fought. Deception may persuade him to come to the wrong conclusions. On the other hand, the enemy may be pressing in considerable strength, allowing little time for preparation and driving in the covering troops early. Again, deception methods already discussed may buy extra time in a critical situation.
14. **Covering Troops in the Main Defensive Position.** Each formation in the main position will be responsible for maintaining covering troops immediately in front of its own position. The position they occupy, or a line drawn in front of it, will be designated the FEBA, a line which separates the areas of responsibility between the covering troops in the main position and the covering force forward of it. Careful coordination between formations is essential to maintain the integrity of the screen and to ensure that one formation's screen is not jeopardized by the withdrawal of its neighbour's either prematurely or under enemy pressure.

SECTION 3 - THE MAIN POSITION

Enemy

15. Enemy infantry can go anywhere, with the rider that they are vulnerable in open terrain, and tanks can traverse most ground, but wheels, on which resupply depends, are much more restricted. The defending commander will select ground where the enemy will have to pause, reconnoitre and plan a series of attacks to winkle the defenders out. The fewer the practicable wheel routes through the position the better. Those not required by our own troops can be blown and mined in defiles where they can only be bypassed with delay and difficulty. Others will be prepared for demolition. The position should be occupied in considerable depth to inflict a high attrition rate on the enemy, force him to expend ammunition and fuel at such rates that the spearhead of a deep penetration runs out of both and exposes itself to attack from the flank. As in other environments, positions should be mutually supporting and prepared for all-round defence. If the ground is sufficiently broken air-portable infantry may hold the main position, allowing the armoured formations to be held in reserve for a mobile role. However, the air-portable infantry's soft-skinned vehicles will have to be removed and sent well to the rear out of artillery range. The risk is that if the battle is lost and the position has to be abandoned it will be difficult to extricate the infantry.

Siting Positions in the Desert

16. The desert offers long fields of view and defending infantry and their supporting tanks have to be concealed from frontal observation. Defilade can be achieved on reverse slopes, on the flat tops of low hills and in wadis and depressions. OPs should similarly be sited so that they look obliquely across the front in a pattern which affords mutually interlocking arcs. While high ground affords long range observation from above the heat haze, obvious peaks should be avoided. The shoulder of a hill combines good observation and defilade. Because of the need to hold only ground vital to the defence in order to release as many formations as possible for a mobile, counter-offensive role, gaps are inevitable. They have to be kept under surveillance. Anti-tank guided weapons can be hidden from direct enemy observation. Their deployment also releases tanks from a purely defensive role to strengthen local reserves for counter-attack and counter-penetration, and for the force's main reserve. Some tanks from local reserves may be given long range sniping tasks in positions from which they can be readily extracted for a mobile role.

Construction of Positions

17. ***Digging Trenches and Pits.*** While wadi beds, depressions and some sand and gravel offer little difficulty in the construction of positions, rock and soft sand present serious problems. High ground is usually hard ground. Power tools and explosives are needed for rock and revetment for soft sand. The MEXE shelter and flexible revetting material have been developed to solve the latter problem. If positions in soft sand are prepared in advance to meet a foreseeable contingency or are likely to be occupied for some time it may be necessary to revet them with prefabricated concrete blocks. In firmer sand and gravel mechanical diggers save time and conserve energy and body fluid. Fire trenches should be narrow, straight-sided and dug flush with the ground. They should be sited to avoid silhouetting the observer and firer against the horizon. Spoil should be removed, mechanised digger tracks erased as far as possible and the trenches camouflaged to harmonize with the surroundings and to hide the giveaway sharp, black shadow from the air. Overhead protection, flush with the ground to avoid tell-tale silhouettes in the open desert, is required for OPs, fire trench shelters and, where feasible, for fire positions for dismounted infantry to reduce casualties from enemy artillery fire, particularly air burst. When available, rock is useful for revetment in the absence of defence stores. Low wire, laid in depth, makes a useful obstacle on the immediate approach to a position. High wire apron fences and concertina wire stand out in the desert to betray a defensive position from ground and air observation. All this adds up to a considerable construction effort, involving more unit labour and engineer resources than in most other environments. Defence stores in the quantity needed in the desert produce a heavy bill for transport which the staff must anticipate early in the planning stage.
18. ***Tank Positions.*** There are two methods of constructing tank fire positions, narrow and steep-sided or saucer-shaped, both deep enough to accommodate a tank hull down. The advantage of the first is that it affords protection to tracks and suspensions from shell splinters. Its disadvantage is that its sharp outline is readily identifiable by airborne surveillance so that a row of such positions constructed for occupation to meet a threat from a particular direction will give away the defender's plan. When

tanks, IFVs and artillery are dug in care should be taken to ensure that they are able to engage targets from all points of the compass speedily because threats may develop quickly from any direction in the desert. Camouflaging large numbers of alternative positions, and keeping the camouflage in place in the normal desert winds, is hardly a practical proposition. The saucer-shaped depressions, scooped out to at least three times the width of the tank, are less obvious but do not provide so much protection. Once a battle is in progress, armoured bulldozers will be in great demand for the construction of new positions under artillery fire. Raised berms of bulldozed sand are more useful for the protection of headquarters and gun positions which are not under direct enemy observation.

The Obstacle Plan

19. ***Location of Obstacles and Minefields.*** The best possible use must be made of any escarpment. A low steep one is an excellent tank obstacle. Soft sand and sebka provide effective barriers to tracks. Gaps between natural obstacles have to be filled with artificial ones, except where the force commander may wish to entice the enemy into a trap or use them to move his reserves. Tactical minefields should be laid to create long, deep barriers to movement in order to force the enemy into a wide outflanking detour which will expose him to a countermove. Apart from tactical and protective minefields, ditches and banks may be bulldozed in suitable ground. Ditches should have near vertical banks on the home side to prevent enemy tanks from climbing out of them. The slope on the far side should be sufficiently steep to break the enemy tank's mine rollers as the vehicle tips forward and to expose the thinner armour on its upper deck to our own tank and anti-tank missile fire. Banks or berms should be built high enough to prevent the enemy from using them as hull down fire positions and steep enough to expose the soft underbellies of tanks climbing them to our own weapons. Ditches and banks should be mined on the home side so that enemy efforts to clear them are exposed to fire. Enemy attempts to gap ditches and banks create bottlenecks which make excellent targets in the open desert.
20. ***The Tactical Use of Minefields.*** All obstacles must be covered by observation and fire, even if only indirect from artillery, mortars and scatterable mines. The latter add to the enemy's casualties, delay and confusion. In addition, bulldozed positions can be prepared for tanks and slit trenches excavated for mechanized infantry which can be occupied by local reserves or a counter-penetration force. The less depth there is to a position the greater the need for a comprehensive obstacle plan to impose more delay in a smaller space. In future, mine and other systems, capable of being laid rapidly or remotely delivered and remotely controlled, ie, switched on and off, will offer increased flexibility, permitting obstacles to be laid in the midst of or in the path of an enemy force. Because mines laid in soft sand and on slopes may shift some distance during the winter rains arrangements must be made to check 'minefield erosion' after a storm and to restore the integrity of the obstacle. It may also be necessary to remark the minefield and to revise the mine records and traces.

Coordination of Positions, Obstacles and Mobile Reserves

21. ***Coordination.*** The force commander, aided by his intelligence staff, will examine every possible axis the enemy may use for real and feint attacks to minimise the

chances of surprise and being caught off balance. He will aim to coordinate his obstacle, deployment and fire plans to force the enemy to enter ground of his choosing where he can destroy the maximum number by a combination of fire power and a well conceived counterstroke. The obstacle plan should be so designed that, in conjunction with the deception plan, including dummy positions, it does not 'bullseye' the defensive layout. Equally, it should be planned in such a way that it neither inhibits the mobility of our reserves nor indicates the axis of an intended counter-attack. Just as in any other environment the commander will nominate key terrain, which must be held at all costs, and if lost, recaptured. He will also designate important ground. As the battle develops he will decide which of the latter, if any, is worth a counter-attack. While key terrain is usually more readily identifiable at formation and battle group level in central Europe, in the desert it is very much the concern of the higher commander.

22. **Mobile Reserves.** A force should be kept in reserve at each level for counter-attack with a number of contingencies in mind, in order of priority, for each of which there must be a fire and movement plan. Ideally, troops should rehearse counter-attacks but if this is not possible, either because of lack of time or for security considerations (the track marks may give away the plan), at least the commanders and their supporting arms representatives should 'walk the course' to familiarize themselves with the ground. The decision to launch a major counter-attack involving a formation will normally be referred to the highest level. The use of reserves in mass for a decisive counter-attack is important in any environment but especially so in the open desert. Indeed, a defensive battle can only be won by the commitment of the largest possible mobile reserve in a massive counter-attack backed by concentrated fire support. The balance between the proportion of the force used to hold the main position, kept in local reserve ready for counter-attack and counter-penetration tasks under sector commanders and retained under the force commander's hand for the decisive counter-attack, requires fine judgment. Put another way, the optimum balance is achieved by a judicious assessment of risks, a calculation of the minimum resources that can at least contain the enemy's main strength in order to concentrate the maximum force to deliver a counter-attack, preferably in the enemy's weakest spot. The more open the country the larger the force commander's main reserve should be. Routes for counter-penetration and the likely alternatives for the counter-attack should also be reconnoitred by commanders at all levels during the preparatory phase.

The Defensive Fire Plan

23. **General.** The lack of cover in the desert lends itself to the exploitation of artillery as a battle-winning factor against an enemy committed to major moves in large concentrations. As a corollary, the enemy can be expected to take advantage of the open environment to neutralize our artillery with a massive counter-bombardment programme. Every artifice of deception, the construction of dummy batteries, firing from temporary positions while the enemy is closing up to and reconnoitring our main defences and masking the fire of batteries deployed in their final gun positions until the last moment, should be used to preserve our artillery in the initial phases. Alternative gun positions must be surveyed and routes to them reconnoitred so that when batteries are forced to move by enemy fire they can be brought into action again quickly and with accurately directed fire.

24. **Targetting.** If possible, DF and FPF targets should be registered while the covering forces are still well out in front of the main position in order to conceal our defensive fire plan for as long as possible. Plans must be made to concentrate defensive fire on likely approaches as soon as the enemy discloses the direction of his main thrusts. Obstacles must be covered by the fire plan and MLRS held ready to scatter mines into the breaches the enemy succeeds in making. The longer range of later generations of MLRS, if available, would enable the enemy attacking forces to be engaged, particularly his follow-up echelons, in depth and to neutralize some of his artillery to degrade his covering fire plan. Target acquisition and fire control will depend on a combination of satellite coverage, air reconnaissance, drones, helicopter observation from behind the FLOT and well sited, carefully concealed OPs dug in on the highest ground available. Such ground is likely to be so vital to the defence that it will be nominated as key terrain.

Camouflage, Concealment and Deception

25. **Concealment.** Although every effort will be made to hide weapons, vehicles, positions, command posts and CSS installations, concealment and camouflage are difficult in the desert, especially in the face of a sophisticated airborne and ground-based radar, thermal imaging and radio intercept system. Great care should be taken to hide heat and light sources from enemy passive viewers, which are effective over longer ranges in the open desert than in Europe. The emphasis will be on concealment, in so far as this is possible, deception and disguise. Initially, tanks should stay close to their fire positions rather than in them and avoid exposure to observation from the front so as not to give away the detailed defence layout. If they have to be in their positions they should remain turret down until it is time for them to engage the enemy.
26. **Deception.** Dummy positions, tanks, guns and vehicles to draw enemy fire not only improve one's own chances of survival but may persuade the enemy to disclose his hand prematurely. Similarly, phoney minefields, easy to fake on hard sand and gravel, can mislead the enemy as to our detailed defensive layout. Care should be taken to disguise the pattern of minefield rows. Mechanical minelayers may be used to trace false rows in the sand to mislead enemy photographic reconnaissance and drone surveillance. Apart from complicating his plan of attack, false rows may initially impose caution and delay.
27. **Use of Obstacles.** Having been duped once or twice the enemy may throw caution to the winds and blunder into some real mines to suffer casualties from both the mines and our defensive fire. A subtle obstacle plan may induce a cycle of caution and recklessness on the enemy involving the loss of men, equipment and precious time. Gaps no longer required for use by our own forces can be mined ingeniously. Run a minelayer over the ground first, then tracked and wheeled vehicles. Finally, lay mines in the minelayer furrows by hand.

Surveillance and Target Acquisition Plan

28. The characteristics of the various surveillance aids have already been described in Chapter 3. It will be necessary to formulate a comprehensive surveillance plan

coordinating interlocking arcs of visual, radar and thermal imaging systems, either ground based or in drones, to obtain warning of the enemy's approach as far out and in as much detail as possible. The surveillance plan should leave no gaps and likely approaches must be covered and registered under the fire plan. Exposed flanks and the rear should not be neglected. Registration is important because maps are often too inaccurate to depend on predicted shoots. At night image intensification sights and viewers will be effective except in dust or smoke, until either our own troops or the enemy use white light. Because there is so little cover in the desert white light will affect thermal imaging sights over considerable distances. Consequently, there must be strict control on its employment, initially at battle group level. Orders should allow its use either when a position is in danger of being overrun or when the enemy starts to use it. The aim should be to illuminate and dazzle the attacker and to catch him at a disadvantage while minimising the same effects on our own troops. The advantages of silhouetting the enemy by firing mortar illuminating bombs on low trajectory into dead ground has already been mentioned. Looking beyond the range of infantry, armoured reconnaissance and artillery counter-bombardment systems and supplementary intelligence gained from radio and other electronic intelligence are the air force's visual, photographic and electronic reconnaissance assets. The latter are not limitless and it will be necessary for the force commander and his intelligence staff to work closely with their associated air headquarters to produce a reconnaissance plan, with tasks and areas listed in order of priority, to cover both the expected threat, other areas from which the enemy may spring a surprise and to keep a watch on the enemy's second echelon, perhaps 80 to 120 kms away.

Identification of Features

29. In terrain where many of the minor features are not recorded on the map, still less given names, it is difficult to pinpoint enemy activity and report its precise location to superior headquarters or to direct fire on to it quickly and accurately. The problem may be overcome by establishing the systems of OPs and surveillance devices with their overlapping arcs, and using resection. While all OPs should have range cards, selected OPs, usually at battle group level, may also have panoramas so that bearings can be determined quickly without the need for repetitive compass work. Unmarked features are given nicknames for ready identification. These, together with range cards, OP logs and panoramas must be handed over to relieving units. Air photographs and satellite imagery are invaluable aids for planning purposes, briefings and the control of fire. To be of any use in featureless desert they must be overprinted with the map grid system.

Control of High and Low Level Envelopes

30. In order to enable the tank and its associated armoured or mechanized infantry to assert their influence and initiative in an offensive role on the open desert battlefield it is necessary to gain control of the low level envelope. Armed helicopters and artillery, working in conjunction, the latter firing airburst, can do much to neutralize the enemy's anti-tank missile system to obtain freedom of manoeuvre for armour. Because there may never be sufficient armed/attack helicopters and artillery to achieve an ideal situation across the entire front, it will be necessary to concentrate

sufficient resources consecutively at critical points to prevent a dangerous enemy break-through, to support a counter-attack to regain key terrain or to ensure the success of the counterstroke. The armed/attack helicopter is vulnerable to anti-tank as well as to anti-aircraft guided missiles fired from helicopters and ground-based launchers. Tactics will vary as the ranges of own and enemy helicopter and ground-launched missiles develop. However, in the open desert, helicopter pilots will have to make the maximum use of what ground cover there is, raising as little dust as possible, and coordinate their attacks with artillery concentrations on known and likely enemy guided weapon launcher sites and OPs. The high level envelope can be dominated over our own troops with a combination of guided missiles and fighters operating beyond the enemy SAM range. This can lead to a situation where the opposing air forces and SAM systems are able to maintain an air defence umbrella over the heads of their own troops but can only penetrate each other's air space at considerable cost. The stalemate can be broken by the kind of ground/air operation described in Part C or the even more elaborate suppression of enemy air defences (SEAD) operation carried out by the allied airforces during the initial air phase of Operation *Desert Sword* in early 1991.

SECTION 4 - THE COVERING FORCE BATTLE

The Covering Force Battle

31. **Direction.** The commander will instruct his covering troops as to how far forward they are to establish the screen initially and how much delay he expects them to impose on the initial FLOT and on any subsequent features. He may also include in his directive the kind of information he wants and an estimate of which axes the enemy is likely to use. He may also indicate the degree of resistance the covering force should offer in an attempt to persuade the enemy to declare his intentions. However, the covering force commander should be careful not to 'make pictures for himself,' in Napoleon's words, and fall a victim to enemy deception.
32. **Selection of Successive Positions.** The initial and successive positions should be selected from features which offer the largest views to both the human eye and electronic surveillance and which enable artillery and armour to engage the enemy at long range. The positions should be defensible for short periods. Inevitably there will be gaps but these should at least be covered by observation or electronic surveillance and indirect fire. Because of the openness of desert terrain these positions are likely to be further apart than in other geographical regions.
33. **Conduct of the Covering Force Action.** Positions should be held long enough by delaying forces with sufficient fire-power to halt the hostile reconnaissance troops, force the enemy to deploy a force of all arms for an attack and, hopefully, identify the axis or axes of his main effort. Having achieved these aims the screen and delaying force should slip away before it becomes seriously engaged, pinned
34. **Withdrawal into the Main Defensive Position.** In effect this is an aspect of a transitional phase of war, the rearward passage of lines. Having withdrawn from bound to bound back to the break clean or handover line, a defensible position out of enemy tank range and, preferably, out of observation of the coordinating points into

the main position, the covering force commander will obtain the force commander's permission to retire behind it. The aim should be to impose sufficient delay to break clean and withdraw through the coordinating points, which may be gaps in minefields, without enemy interference. If, as is likely in the open desert, the withdrawal is contested fire support will be provided from the main position. Covering troops will close the minefield gaps behind the last vehicles. Good liaison between the elements of the covering force is necessary to ensure that the defensive fire plan works and that the covering troops on the main position know when the last vehicles pass through the FEBA. In accordance with current doctrine responsibility passes from the covering force to the formations in the main position on the FEBA. The handover line may be occupied by troops from the main position to check an enemy attempt to burst through on the heels of the covering force and bounce the main position. The recovery plan should allow for the additional effort which may be needed to bring damaged tracked and wheeled vehicles rapidly back through the coordinating points into the main position to avoid their becoming choke points, providing enemy air and artillery with attractive targets and blocking the withdrawal of the covering force.

SECTION 5 - THE DEFENSIVE BATTLE

The Battle on the Main Position

35. **The Screen.** After the covering force has withdrawn through the FEBA, the formations holding the main position will be responsible for their own security with the normal screens and guards. Covering troops will aim to prevent close reconnaissance of the main position and secure gaps in minefields and other obstacles, such as anti-tank ditches, for as long as these are required by our reconnaissance patrols and raiding parties. When the covering troops are withdrawn in another rearward passage of lines operation, preferably by stealth in the desert but if necessary under the cover of pre-planned defensive fire, the remaining gaps in the obstacle plan will be closed. Thereafter, no-man's-land should be dominated by aggressive patrolling and ambushes.
36. **Occupation of Battle Positions.** Infantry will normally remain in the trenches they dig on the main position. Their IFVs or APCs can either be dug in on defiladed positions close by to thicken up the defensive fire or be held further back under cover. In either case they are readily available to move their infantry. Tanks supporting infantry in the forward area may have a number of positions, prepared or not, to which they can move, as appropriate, when the enemy attack develops. After each engagement tanks should move to alternative positions. Should a sandstorm blow up they will usually move to their main position in case the enemy should exploit the lack of visibility to make a surprise attack. In such conditions standing patrols should be sent out into previously reconnoitred positions to fill gaps in the observation, surveillance and target acquisition coverage which will be severely degraded by masses of blown sand.
37. **Use of Surveillance Devices and Opening Fire.** Because active surveillance devices, range finders and target markers can be spotted by the enemy at great distances in the desert, it is important to use the passive aids for as long as possible. Troops should only go over to the active mode and open up with direct fire weapons

when the enemy are committed within effective range and are attempting to negotiate our obstacles. The attacker will be caught at the moment of greatest disadvantage, giving our own troops the opportunity to inflict the maximum damage and shock while keeping our positions concealed for as long as possible. While armour and anti-tank guided missiles are engaging the enemy attempting to cross minefields and other obstacles at their optimum range, infantry should hold their fire until the enemy close with their positions. Although this is a sound policy in any environment it is even more important in the open desert with its long views and lack of cover. Opening fire prematurely will not only invite damaging return fire but will give the enemy the opportunity to use what cover there is for shelter and manoeuvre. However, bearing this rider in mind, the defender who judges the timing correctly and opens fire first scores an immense advantage. The authority to change from the passive to the active mode and to open fire will probably be vested at battle group level initially but may be delegated to squadron/company groups in exposed positions. Implementation requires clear orders, good discipline and nerve.

38. **Indirect Fire Support.** MLRS and armed/attack helicopters are able to engage an approaching enemy in great depth, particularly his second echelon and artillery elements, on the information provided by RPVs and other surveillance devices, to disorganize, delay and destroy a significant portion of them before they can be committed against forward positions. Artillery and mortars are able to open fire at long range against the enemy's leading elements to start the process of attrition on those forces which pose the immediate threat to us. Initially, the enemy will find it difficult to locate artillery and mortar positions, particularly if defensive deception plan have been good. Later guns and mortars may have to move to alternative positions, which have already been surveyed, to avoid counter-bombardment. Shell and mortar fire force the enemy to close down, restricting the vision of tank and IFV commanders and making it more difficult for them to locate our positions, even in flat and featureless desert, when engaged with direct fire weapons. Artillery should be concentrated on selected targets using a minimum of three batteries, and possibly as many as 12 or 15, to achieve the greatest effect. On a wide front it will not be possible to stop the enemy everywhere but sufficient weight of fire has to be concentrated in defence of key terrain where the enemy is likely to make his greatest effort. Even if some penetrations do occur the use of concentrated artillery against major thrusts, preferably in turn, should dislocate his attacks and desynchronize his plan. In the open desert where there are fewer natural obstacles than in European terrain the disorganization of a concerted enemy manoeuvre is as important as the infliction of casualties. Enemy attempts to create gaps in minefields and pass troops through them may be harassed, delayed and perhaps thwarted by the use of scatterable mines remotely delivered.
39. **Armed/Attack Helicopters.** As the enemy attack develops, one of the quickest means of bringing fire to bear on his armour is the armed/attack helicopter. Its use helps to conserve the armoured reserve. It pays to use armed/attack helicopters in worthwhile concentrations, moving them up previously reconnoitred covered approaches in a steady stream to carefully selected RVs to deliver their attacks from a flank, defiladed and down-sun. The commander of the formation being supported should lay down target priorities: enemy weapons which threaten the helicopters, tanks, engineer plant clearing passages through obstacles and command vehicles,

if they can be recognized. The pilots should have had the opportunity to reconnoitre likely tasks and covered approaches before the battle.

40. **ECM.** SIGINT provides valuable information on enemy activity and intentions. Used in conjunction with other intelligence sources it will indicate profitable ECM targets. Just as artillery is most effective when used in heavy concentrations, so ECM, directed at a particular enemy formation to interfere with as many of its command and fire support nets as possible, will have a far more dislocating effect than using it piecemeal. Used in conjunction with artillery and armed helicopters it may complete the disorganization of an enemy attack at a crucial moment. If bad going forces the enemy to use widely separated axes the disruption of the attack on one of them, even for a few hours, may upset his whole plan and allow the defender's inferior resources to be concentrated on each threat in turn.
41. **Air Support.** Provided that the enemy's air defence surveillance and control system can be degraded by a combination of jamming, missiles, long range artillery and air delivered weapons, conditions may be suitable for the employment of air power. With the long distances and lack of cover in the desert, air power may best be used in an interdiction role against the enemy's second echelon and logistic system, particularly vulnerable supply convoys. Close air support, guided by laser target markers in featureless deserts, may be useful, especially in a critical situation to help hard pressed counter-penetration forces stem a dangerous breakthrough or to support an important counter-attack to regain vital ground.
42. **Local Countermoves.** Sometimes a counter-attack mounted quickly will succeed against a disorientated enemy before he has time to reorganize on a captured position. Once this opportunity passes the local commander should weigh up the chances of success with the resources at his command. Attacks are best mounted from an unexpected direction. As the battle develops and the enemy penetrates the position to capture key terrain, the formation commanders in the main position will commit their counter-penetration forces and their reserves initially to execute pre-planned tasks and then to meet the unexpected as the enemy plan unfolds. Gradually the reserves will dwindle. New mobile reserves must be formed because in a mobile battle they are the only means through which commanders can influence the situation. Reserves must not be frittered away. For the sake of maintaining intact reserves less important ground which is lost should be abandoned so long as key terrain is held. Nevertheless, within their resources the forward formation commanders may be able to exploit opportunities which cost the enemy precious time, throw his plans out of gear and exact an unacceptable rate of attrition. Should the enemy possess a marked superiority in armour a more circumspect policy of counter-attacking with fire from a flank, rather than attempting to recover lost ground, may be expedient.

CHAPTER 5

DELAY OPERATIONS

SECTION 1 - THE SETTING

General

1. **Necessity.** In certain circumstances it is possible that the enemy may be stronger, more balanced and in a position to attack. There will be little time to create artificial obstacles but scatterable and remotely delivered mines could provide useful obstacles.
2. **Limitations.** Without a firm static element a mobile delaying defensive operation cannot be maintained indefinitely in the open desert against a more powerful enemy. The best that can be hoped for is to maintain the force in being, using space as a reserve and giving ground as sparingly as possible, until either reinforcements arrive to enable us to turn the tables on the enemy or sufficient time has been gained for the preparation of a defensive position further back. In the latter case the mobile delaying force will aim to break clean and withdraw.

Conduct of a Delaying Action

3. In a mobile delaying battle in the open desert the attention of commanders and observers tends to be riveted on major events. The infiltration or movement round a flank of small groups of tanks and infantry often escapes notice, especially if the enemy uses what terrain cover there is skilfully. These two combat arms have a tendency to look at the battlefield from different perspectives, determined by the range of their weapons, the tank commander searching the ground and engaging targets out to 2,000 metres and beyond while the infantryman's attention is engrossed by events within a few hundred metres of him. These differences in perspective can be put to good use, the one arm warning the other of threats in its blind spots. However, beware the gap in the middle. Both arms have to consciously restrict or extend their foci of attention to cover the middle distance.
4. By day, armour will hold the front backed by anti-tank guided weapons in rear operating from such defiladed positions as the open, gently rolling desert offers. In turn the anti-tank guided weapons should be protected by mechanized infantry. In the open desert air defence cover is even more essential than elsewhere. Armed helicopters will operate well back taking advantage of any contours to provide covered approaches.
5. At night the security of the armour and its replenishment may be accomplished in one of two ways, depending on the aggressiveness or supineness of the enemy, the proximity of the two forces and the availability of covered routes behind the position occupied by the tanks:
 - a. The infantry come forward after dark to the nearest position which affords cover from view to protect replenishment points to which tanks are withdrawn singly.

- b. In very open desert the tanks retire individually behind the next bound, where the armoured infantry and anti-tank guided weapons are positioned, for replenishment in reasonable security. In either case the passive thermal imaging and gunnery systems of the majority of tanks remaining on the position plus the surveillance of artillery OPs can observe the front. The risks inherent in pulling back all the armour behind the security of the infantry is that if the enemy observes a consistent pattern on successive nights he might advance to seize the abandoned position in the dark. The disadvantage of replenishing forward is that shellfire could cause casualties and seriously dislocate the refuelling and re-arming of the tanks.
6. In a mobile defensive, delaying action every effort will be made to bluff the enemy into believing that the defending forces are stronger than they are. Opportunities will occur for limited offensive operations, manoeuvring tanks to engage the enemy by surprise, from an exposed flank and from up-sun. When withdrawal becomes necessary chances may occur to ambush an over-confident enemy following up incautiously or to launch a spoiling attack from a flank exploiting the long range of tank guns and the longer ranges of armed helicopters. A few successful ambushes may induce a greater degree of prudence on the enemy. At night there may be occasional opportunities for a stealthy infantry raid on isolated enemy positions but the universal use of night vision aids will reduce the possibilities of surprise and success to places where the approach can be made in dead ground.
7. Weak ground forces will rely on armed helicopters and close air support to maintain a coherent front. However, unless the enemy's SAM system can be neutralized by ECM, artillery and air weapons the air force may suffer unacceptably high losses.
8. Last man, last round defence is inappropriate in a mobile defensive delaying battle. Our forces will aim to avoid encirclement. If a position is surrounded its garrison will attempt to break out under cover of darkness or a dust storm, aided by mobile forces outside the encirclement giving direct support, creating a diversion or both.

SECTION 2 - THE MOBILE DEFENSIVE BATTLE

Design for Battle

9. A lack of commanding hills and natural obstacles can be compensated for by fighting the battle in considerable depth within the range of our air defence umbrella and by the skilful exploitation of good and bad going. Any time the enemy allows should be used for the construction of anti-tank ditches and tactical minefields of considerable length, linking what few natural obstacles, such as shallow escarpments, that nature affords. Behind these minefields are stationed armoured formations in assembly areas ready to move to a threatened sector on the obstacle, or to block or counter-attack enemy bypassing it. Still further back, other formations will similarly be stationed behind other artificial or natural obstacles. These formations will form a skeletal framework within which the main mobile reserve can manoeuvre. Because the outcome of the battle will depend mainly on the use of the main reserve should be as large as possible.

10. The gaps between these positions will be much wider than in a normal defensive position. They must be watched by the mobile patrols of armoured reconnaissance regiments, surveillance devices, including airborne radar and helicopters. At least one flank is likely to be open and will require a combination of a screen and air reconnaissance.
11. The covering force will need to be strong enough to stop the enemy's light reconnaissance troops and oblige the opposing commander to commit his main body. Compelling the enemy to deploy will buy time and help to determine his axis of main effort.

Fighting the Battle

12. As the covering force retires and the direction of the main enemy axes of advance become apparent, the forward formations use the tactical minefields to stop frontal attacks, employing armoured or mechanized infantry-heavy battle groups with the support of anti-tank guided weapons and artillery. The armour-heavy battle group should aim to counter-attack the enemy's mobile forces from the flank. Some penetrations may be defeated but the enemy's main thrust is likely to force its way to the depth positions and perhaps beyond. The covering troops may be used to watch an exposed flank and the gaps between the depth positions. Within the air defence envelope a combination of armour holding the flanks of the penetration, armed/attack helicopters, close air support and artillery fire should inflict a heavy attrition rate on both the enemy's combat troops and his resupply convoys. Similarly, the enemy's armed/attack helicopters and air force will suffer heavily operating in a hostile air environment.
13. At some stage the enemy thrust will slacken through a combination of casualties, obstacles, bad going and a lack of all kinds of supplies. The problem will be to recognize the opportunity in sufficient time to exploit it. So long as the intelligence staffs have been watching for the right indicators the occasion will provide the opportunity for the commander to commit his reserve in a concentrated fashion. To succeed, the blow should be launched on good firm going supported by a maximum effort from armed/attack helicopters, the air force and all the artillery which can be concentrated within range. Some of the units which have been bypassed may be able to launch attacks, at least strong enough to distract the enemy, from other directions. ECM should be particularly effective against an overstretched enemy trying to regroup to meet one or more threats.
14. Deception may be employed in a number of ways. Dummy concentrations may mislead the enemy as to the position of the main reserve, especially if electronic silence is maintained by the real reserve and radio traffic simulated to and within the dummy reserve. As previously mentioned, a phoney minefield located across the main reserve's axis of attack may persuade enemy intelligence that no attack is likely from that direction. The move of the reserve to the assembly area for action may be possible at night if the going is good and there is some moonlight. Although driving with night vision aids is technically possible in starlight the clouds of dust thrown up by many vehicles may cause sufficient degradation to delay the move and dislocate the plan.

SECTION 3 - THE WITHDRAWAL

Circumstances

15. **Types of Withdrawal.** A withdrawal operation may be:
 - a. *Planned.* As a deliberate operation to trade space for time space when threatened with overwhelming numbers or to reduce commitments to create a concentration to force a decision in another part of the theatre. If only an expanse of valueless desert is at stake withdrawal does not have quite the same political and military consequences as it does in central Europe. A commander in a desert theatre may have a little more freedom of action than his counterpart elsewhere.
 - b. *Hasty.* As a consequence of defeat in order to extricate as many of our own formations intact as possible so that they can be reorganized on a position further back. The intention will be to resume the offensive as soon as individual reinforcements have been absorbed and trained, equipment repaired or replaced and the force augmented by fresh formations. Withdrawal is the most difficult operation of war in any environment but in the open desert it is the hardest, the most hazardous and testing operation likely to face any commander and his troops.
16. **Maintaining a Mobile Force.** So long as an intact, mobile force can be kept in being caution may be imposed on a superior enemy and time may be bought to recuperate and go over to the offensive. Once an effective, mobile, armoured element ceases to exist little or nothing can be done to influence the course of operations. In an adverse situation it is necessary to trade space for time, even if it means abandoning forward bases with large stocks and other useful facilities. The reasons for a withdrawal has to be clearly explained to higher authority and pressure to attempt a premature defence or a large scale countermove too far forward with too few resources and on unsuitable ground must be resisted, even though the force commander may become unpopular for doing so. The troops have to be withdrawn to the next defensible position sufficiently far back to stretch the enemy's lines of communications and compel him to pause. In these circumstances a weaker defender will be able to regain the initiative with countermoves against an overstretched and unbalanced enemy. Both sides could be exhausted after periods of moving and fighting but the first success the defender scores will provide a useful fillip to morale.

Principles

17. As in other theatres a commander will be guided by the following principles, although their implementation will be far more difficult in the open desert:
 - a. *Break-Clean.* A clean break may be achieved quite easily in a planned withdrawal from a prepared position with the help of a good deception plan. However, it will be extremely difficult to break off an engagement in open terrain after a tactical defeat against a determined enemy buoyed up by victory and bent on exploiting his success to the uttermost.

- b. *Intact Front.* The deployment of a strong covering force is necessary to maintain an intact front to allow the main body to withdraw with the minimum of interference. In the wide expanses of desert terrain the maintenance of a coherent front will be difficult. Helicopters, both reconnaissance and armed or attack, must be kept in readiness to watch any gaps which may occur and to provide a reserve of firepower to impose caution and delay on an enemy attempting to exploit them.
 - c. *Rear Area Security.* It is necessary to protect the withdrawal routes from enemy air attack, airborne activity and outflanking manoeuvres. One of the main threats will come from a parallel pursuit in deserts where the going is good. An effective air defence will be essential with transport using one or two surfaced roads or raising clouds of dust on tracks across sand or gravel to betray movement in the open desert and inevitably, bunching at choke points under enemy air or long range missile attack in spite of the best efforts of traffic control.
 - d. *Balance.* Every effort must be made to maintain as well balanced a force as possible in the circumstances. Existing groupings should be preserved to retain cohesion. The problem is to allocate just sufficient covering forces to hold the enemy off while the bulk of the force moves as fast as possible to prepare the next main position or an intermediate one, or both. Sufficient reserves have to be kept in hand to extricate the covering troops, should they be pinned down, or to block a penetration. The former contingency is likely to occur frequently on a flat gravel or firm sandy plain because tanks, IFVs and APCs become exposed as soon as they leave their fire or hide positions. Enemy penetrations can develop with alarming speed and reserves must be kept in hand to prevent enemy exploitation.
18. The maintenance of control, cohesion and morale makes heavy demands on leadership and organization, particularly in a hasty withdrawal. Should the enemy injudiciously expose an element of his force to a quick and limited countermove, the opportunity should be recognized and taken. Caution will be induced on the enemy, delaying his pursuit and a small success will have a heartening effect on our own troops' morale.

Planning a Withdrawal

19. ***A Withdrawal in One or More Stages.*** Ideally, the force should move straight back to the next main position rather than occupy a series of intermediate ones. The new position can then be organized and prepared as a complete and coherent entity, rather than piecemeal as and when formations arrive on release from successive intermediate positions. The covering force may be able to impose some delay, allowing the main body more time to lay minefields and construct defences.
20. ***Intermediate Positions.*** These should only be occupied if it is necessary to buy extra time to reform a force disorganized by a severe defeat and to prepare the new main position. Intermediate positions can only be used to impose worthwhile delay without incurring unnecessary casualties if there are sufficiently good natural defences and obstacles to allow a weak force to hold them with a reasonable chance of success.

They should be spaced out between the old and the new main ones, and each other if there are several, to oblige the enemy to redeploy his artillery and go through all the preparations for a major attack on each in turn.

21. **New Main Position.** As many formations as possible should be sent back to work on the new main position. Its preparation, involving a major engineer effort, to lay larger minefields and construct longer obstacles than in other theatres, and the considerable work to excavate weapon pits and shelters in difficult ground and rock need time. Reconnaissance parties and engineers should be sent back to coordinate and lay out the new position before the old one is abandoned. Initially, the organization of the new one may be delegated to one of the force commander's senior subordinates, for example, if the force is an army a corps commander and his headquarters may be used for the task.
22. **Covering Force.** To impose any effective delay the covering force should be as strong as possible in fire power, especially mobile fire power, such as armed helicopters and armour. Following a defeat the tank strength may be so depleted that the armour available to the covering force is insufficient. However, in a withdrawal, armed helicopters flying nap-of-the-earth and anti-tank guided weapons firing from such defiladed positions as the terrain offers under a defensive air system may be able to compensate for a lack of armour. For ease of command and control and to avoid the creation of gaps on formation boundaries, the covering force task should be given to a complete formation, perhaps a third of the total, reinforced by armoured reconnaissance regiments and army aviation. The air defence system should be left intact for as long as possible to give the covering force adequate protection.
23. **Reserves.** The covering force will have to find its own reserves to extricate threatened elements, block penetrations and parry outflanking moves from an enemy parallel pursuit. With the rest of the formations moving back to the main position, and perhaps intermediate ones as well, it will be hard to find a force reserve. A small one may be formed from any troops which can be spared from manning the FLOT on the main position but the commander will rely mainly on keeping his covering force intact, plus any troops released on the abandonment of any intermediate position.
24. **Counter-Mobility and Mobility Support Planning.** The following factors must be taken into account when making the obstacle and mobility support plans to cover a withdrawal:
 - a. The force commander, in conjunction with his engineer adviser, will decide on the division of resources and effort between preparing the next main defensive position and any intermediate positions, helping the covering troops on the old position to break clean, imposing some delay between positions and repairing the withdrawal routes to keep his forces moving. The major engineer effort will normally be devoted to the preparation of the main defensive position, particularly if it has not been possible to work on it previously in anticipation of a withdrawal.
 - b. If the force commander hopes to turn the tables on the enemy shortly, he and his engineer adviser will control the siting of minefields carefully, using self-destruct, timed deactivating fuses or, in future, remotely controlled mines.

- c. Time and resources will be short, especially for the creation of obstacles behind the old position to facilitate a clean break. The emphasis will be on rapidly laid mines behind our own troops and remotely delivered and scatterable obstacle systems beyond the FLOT to supplement natural obstacles or conventionally constructed ones in defiles. Standard 800 metre mine panels can be laid parallel to the front with 600 metre gaps between them. Alternatively, minefields can be laid perpendicularly to the front with phoney minefields and gaps between them. When the covering troops withdraw the gaps and phoney minefields can be closed with scatterable mines.
 - d. All obstacles through which our forces are to withdraw must be especially well marked in featureless desert to prevent casualties and unnecessary delays. Gaps through artificial obstacles and defiles, either on the withdrawal routes or at intermediate positions, will be marked, guarded and included in the traffic control organization. Liaison officers with communications to both the covering force and the commander of the appropriate sector of the intermediate or main position must be stationed at the gaps to check the covering forces through. The gaps will be closed by engineer parties or remotely delivered mines on the orders of the sector commander when the last of the covering troops have passed through.
 - e. All elements of a withdrawing force, and particularly the covering troops and any deception forces who move out last, will need engineer support to maintain their mobility and to prevent traffic jams concertinaing to provide the enemy air force, long range artillery or his pursuing troops with lucrative targets. Engineer tasks will vary from repairing desert tracks and mix-in-place roads, which disintegrate under heavy traffic, especially on soft going and in defiles, to rebuilding routes which have been damaged by enemy battlefield air interdiction at bottlenecks which cannot be bypassed. Again, the engineer commander must reconcile the competing demands on slender resources of manpower and plant for mobility support and counter-mobility during the withdrawal and the preparation of the new main position.
25. **Denial Plan.** Apart from demolitions and nuisance mining on routes through defiles, a plan must be made early to deny the advancing enemy the use of ports, airfield runways and installations, and railways. Stocks, especially of fuel, water and food, as well as ammunition, which cannot be lifted back must be destroyed. Because dispersed ammunition stocks take time to destroy priority must be given to the destruction of mines which can be used against us. A decision on whether to destroy or salinate water sources may have to be taken at a high level for political as well as military reasons.
26. **Air Defence Vulnerability.** A withdrawing force is vulnerable to air and missile attack and to long range artillery once it leaves its defensive positions and moves back down the few tracks and roads which allow fast movement. If the going is good units can move in open formation but the clouds of dust they raise attract enemy attention. If the force has suffered defeat, repeated hammering from the air could badly disorganize the withdrawal and sap morale.

27. ***Air Defence Protection.*** Even in a situation of air inferiority, our air force should be able to provide adequate protection within the area covered by our ground based air defence system supplemented by the Army's weapons. In a long withdrawal these ground based defences may be stretched dangerously thin, particularly as a proportion of our SAM launchers and radars will be on the move. A well thought out plan is required to deploy the air defence resources to give point defence to bottlenecks, intermediate positions, gun areas, headquarters and combat service support installations on a priority basis and area cover to as much of the withdrawal route as possible. At least it should be possible to provide an effective system on the new line to cover the move of formations into their sectors and the preparation of positions.

The Conduct of a Withdrawal

- 28 ***Timings.*** The force commander will decide on the usual timings to control a withdrawal. These are:

a. *Mandatory*

- (1) The time up to which the old position is to be denied to the enemy, the key timing for the whole withdrawal plan.
- (2) The time before which there will be no thinning out, except for formation and unit withdrawal reconnaissance parties and routine traffic to present a picture of normal activity for as long as possible. However, this restriction on movement will only hold for deliberate withdrawals which are not undertaken under pressure. In a hasty withdrawal after a defeat the reconnaissance parties will move as quickly as possible.

b. *According to Circumstances*

- (1) The time thinning out may start. In a hasty withdrawal such a control would be superfluous. In a deliberate withdrawal the force commander may well make the time mandatory to conceal his intentions for as long as possible. In the open desert there are obvious advantages in doing so.
- (2) The time by which troops are to be clear of a line behind the old position. This is particularly useful in providing a framework for the control of fire support, especially in giving artillery and armed helicopters a free hand with confidence that they are not in danger of attacking our own troops. Ideally, the line should be drawn along some feature clearly identifiable on the ground and from the air, like the enemy side of a wadi. In bare terrain a line between such features as there are, perhaps several miles apart, or even a map grid line may have to suffice. The line should be a safe distance ahead of the covering troops if they have been deployed behind the main position before the withdrawal begins. In addition, the positive fire clearance methods described elsewhere should be used to ensure the safety of our troops in what will probably be a difficult, fluid situation.

29. **Sequence.** Diagrammatic examples are given in Figures 5A-5C. In a deliberate withdrawal the sequence will be the same as in central Europe:
- a. Reconnaissance parties and non-essential vehicles move back under cover of darkness and according to a timed programme in order not to present a picture of sudden, massive movement to enemy ground and airborne IMINT.
 - b. The covering force deploys behind the main position. Local reserves take up station. The depth squadron/company groups prepare to cover the forward ones back through them if the withdrawal is likely to be interfered with.
 - c. The withdrawal begins, ideally at night, when the depth battle groups and squadron/company groups move first, leaving the forward sub-units to hold the old position. Tanks in forward fire positions may withdraw as usual after dark to replenish and then keep going while the infantry and anti-tank weapons to their rear cover them out. The infantry and their missiles then follow. If the enemy discovers the move and follows up promptly the defenders can impose caution and delay on him by firing white light to dazzle his tank and IFV commanders and drivers, weapon operators and FOOs, as well as to bring down accurate fire which will force commanders to close down and rely on the narrow fields of their night vision aids which white light will degrade.
 - d. If a withdrawal has to be conducted in daylight it can only be achieved by fire and movement, depth squadron/company groups and battle groups covering out those in front. Artillery support will be provided by batteries leapfrogging back in turn. Armed helicopters, using what terrain cover there is to fire their missiles from a flank, should prove effective, particularly if coordinated with artillery fire to force tanks to close down. Enemy armour which penetrates the FLOT may be particularly vulnerable to armed helicopter attack. The aim will be to slow down the enemy advance and halt it long enough for our forward troops to break clean.
 - e. As the withdrawing force moves through an intermediate position or the final position the normal procedure for a rearward passage of lines operation will be employed. As in the withdrawal of covering troops into a defensive position the responsibility for command will change at the handover line. The formation *in situ* on either the intermediate or final position will provide protection for the passage of the withdrawing forces through the coordinating points. These will have to be clearly marked if they are to be recognized in the dark and guides may be needed. Should the enemy pursue aggressively on the heels of the withdrawing troops and threaten to jeopardize the operation or bounce a new position it may be necessary to halt one of the retiring battle groups or squadron/company groups to act as a counter-penetration or counter-attack force under the command of the formation holding the new position.

Security and Deception

30. **Security.** In a deliberate withdrawal every effort will be made to present the enemy with a picture of ongoing routine, sticking to normal traffic and communication patterns

NOTES:

1. Rear recce parties despatched under Bn 2IC to recce next posn.
2. Wdr of non-essential vehs, eqpt and pers.
3. Radio sy. Radio silence or normal traffic?
4. Maint of normal routine.
5. Firm con of thinning out.

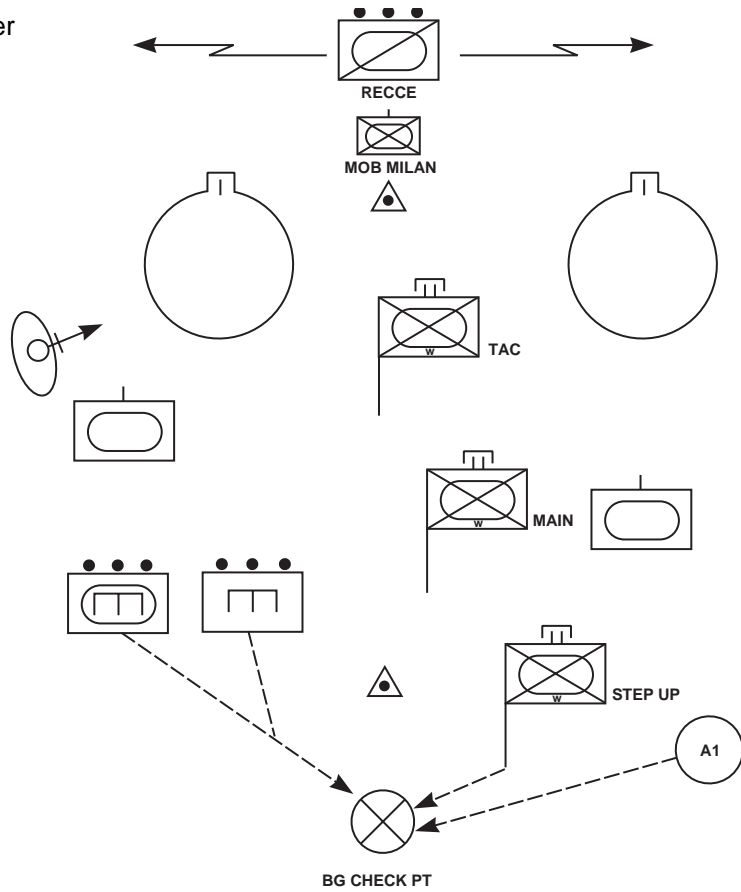


Figure 5-A Battlegroup Withdrawal - Phase 1

NOTES:

1. **Functions.** Wdr fwd sub-units, inf first if threat is mainly from army. MICVs move fwd to pick up inf at RV, if in contact.
2. Armr covers moves back.
3. Engrs prep obs on new posn and prep delaying tasks on old posn if time allows.
4. **Wdr Procedure.**
 - a. Pls thin out to PI RVs, mount vehs.
 - b. Through Coy Check Pt, manned by CSM.
 - c. To Coy RV. Minimum time to be spent there. Depart once all sub-units have assembled.
 - d. Move to BG Check Pt/Start Pt (manned by Adj/RSM). Timings for crossing Start Pt given in wdr Os.
 - e. Mov as per mov O to BG RV/Rel Pt, manned by Bn 2IC and Coy guides. Sub-units pick up guides and move direct to new posn/new assy area. Minimum time spent in BG RV/Rel pt.

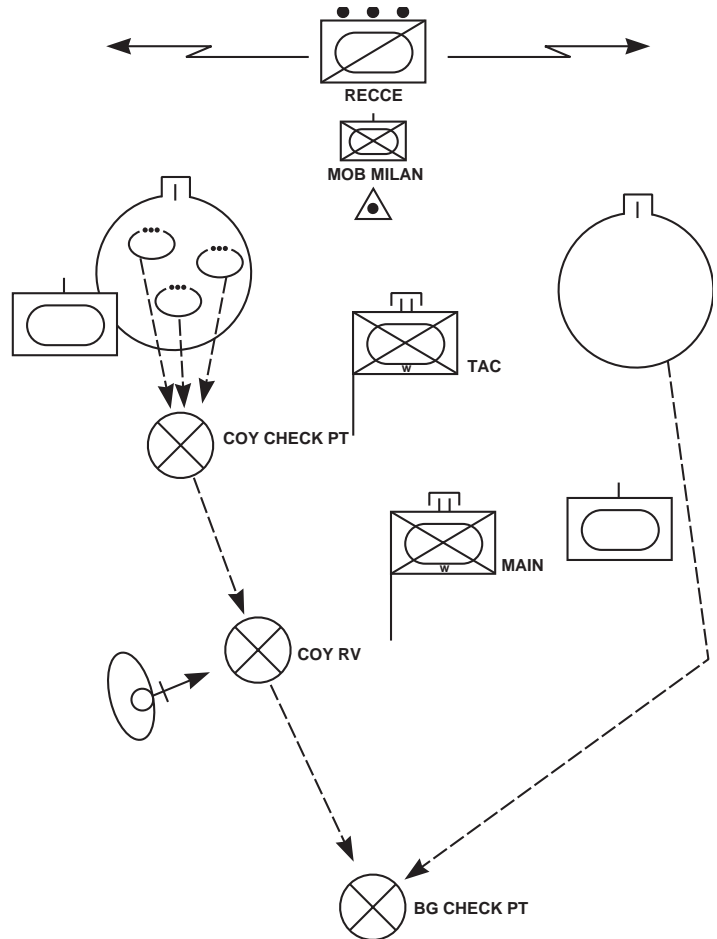


Figure 5-B Battlegroup Withdrawal - Phase 2

NOTES:

1. **Armr.** Wdrs as per coys. Use bounds if in contact.
2. **Arty.**
 - a. Useful for deception.
 - b. FOO/MFC remain well fwd to con deception/delaying fire.
3. **Comd and Con.** BG Main HQ wdrs once sqns begin to wdr. BG Tac HQ to stay well fwd until last possible moment.
4. **Recce.** To maintain contact with en until:
 - a. All sub-units are clear.
 - b. Until sub-units join in new loc.
 - c. As ordered.
 - d. May also be called upon to provide TC along wdr route if not in contact.
5. **Mors.** Cover wdr as long as possible. Mov on orders.

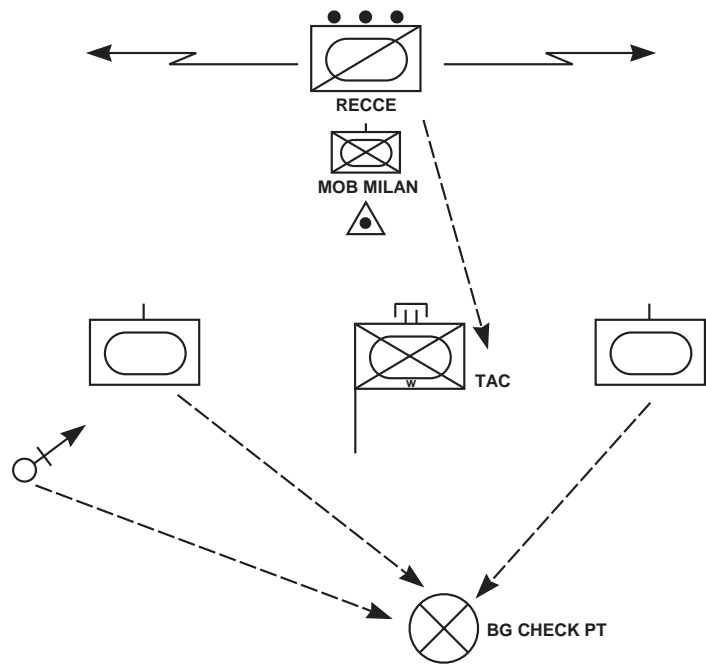


Figure 5-C Battlegroup Withdrawal - Phase 3

up to the last minute. Artillery fire can be programmed to interfere with enemy replenishment soon after last light over a period of some days beforehand so that the noise of our tracks withdrawing over the desert will be drowned sufficiently long to break clean.

31. **Deception.** A large scale withdrawal to a more readily defensible position in order to reduce a commitment or release formations and logistic support for some other part of the theatre will be the easiest to conceal because the enemy may not suspect it. In such circumstances with the initiative there would be more time to prepare and put into effect a credible deception plan. More often, enemy intelligence will appreciate the intention to withdraw in the near future and the aim of deception will be to mislead him as to the date. Formations withdraw gradually with returning supply convoys at night, their empty positions remaining camouflaged with metal sheeting placed underneath to provide a radar and heat return to simulate the missing vehicles. Combined with routine vehicle movement and a normal radio traffic pattern these ruses may deceive the enemy for a few vital days. However, while reconnaissance of the new position may go undetected, a convincing cover plan will be necessary to explain any work on it, which will readily be picked up by modern surveillance. Except in a hasty withdrawal forced by overwhelming enemy pressure, the plan should include a deception element.

Hasty Withdrawal and Encirclement

32. The worst case is the need for a precipitate retreat after a heavy defeat to avoid encirclement and destruction. There will be no time for the detailed battle procedure for a deliberate withdrawal. The force commander will nominate a readily defensible position well in rear where there is a good chance of making a successful stand and will order all forces not committed to withdraw there, preferably under cover of darkness. The troops in contact will impose as much delay as possible, striving to maintain an intact front. It may be necessary to conduct a fighting withdrawal using fire and movement. The enemy should be kept at arms length by exploiting such features that exist to open fire at maximum effective range and by using remotely delivered mines.
33. Armed/attack helicopters and ground attack aircraft may be able to impose significant delay. If a suitable feature exists on which to hold up the enemy it may be possible to organize it as an intermediate position, to be held by the most intact formation left on the old battlefield. This would enable the other forward troops to break contact and reorganize on the main position. If not, the commander will have to fight his way back the best he can to the main position. Provided fuel stocks which cannot be carried back are destroyed and the withdrawal is long enough the enemy may run short of fuel.
34. Having helped the forward troops to extricate themselves from the stricken battlefield, the air force may best be employed in three ways:
 - a. By maintaining or regaining a favourable air situation.
 - b. By carrying out interdiction missions to slow the enemy advance by the attrition of his lengthening supply system and by attacking troops on the move before their air defence system can be properly organized.

- c. In a dire emergency, such as a serious enemy breakthrough, by providing close air support.
35. Encirclement and destruction is a very real fear in the chaotic conditions of a lost battle and a hurried withdrawal. The best means of avoiding encirclement are good information and mobility. However, in such conditions there may be a lack of information and such as there is may not reach a threatened battle group or formation in time. If a battle group or a formation is surrounded the best chance of extricating it is for its commander to make a rapid estimate as to where the weakest point in the encircling forces is and a quick decision to exploit it. Even with modern surveillance aids the enemy's intelligence picture may be confused and incomplete. Night may provide the best opportunity to exploit the confusion which will almost certainly exist on the other side. A concentrated lunge at the estimated weakest link, preferably in an unexpected direction, offers the best chance to a battle group or formation which still retains its cohesion. Once this is lost the only remedy is for the encircled commander to authorize small groups to break out in all directions in the hope that most will get through. The weakest link in the enemy cordon may be directly towards him, his main strength having been committed in the encircling operation to create a blocking position in our rear. In the chaos of a mobile battle an enterprising commander can lead his troops on a circuitous route to rejoin the main body further back.

Command

36. ***Position of the Commander***

- a. *Planned Withdrawal.* When there is time to deploy a covering force the overall commander, with his tactical and main headquarters, should move back to organize the next position, leaving a subordinate formation commander to handle the withdrawal of the covering force. However, if an intermediate position is to be occupied the force commander will probably remain behind it in his tactical headquarters long enough to coordinate the rearward passage of lines of the covering force. Once the intermediate position is abandoned the force commander will rejoin his main headquarters.
- b. *Hasty Withdrawal.* With two or more formations deployed the force commander will have to remain forward with his tactical headquarters to control the withdrawal, sending his main headquarters back behind the final position. If it is possible to organize an intermediate position to be held by one formation, he will leave it to rejoin his main headquarters once the intermediate position is abandoned.

37. ***Morale.*** The worst threat to morale in a withdrawal over long distances in the desert is the uncertainty of the situation and the fear of being overwhelmed or cut off. On the assumption that the morale of the troops is basically sound the fear of the unknown can be allayed by keeping everyone as well informed as possible about the situation, future intentions and the support which is available from other battle groups, formations and the air force. Rumours which spread alarm should be scotched at once but this can only be done if the local commander is sufficiently in the picture to

be able to reassure his troops. Any opportunity for a successful local countermove should be taken in the interests of encouraging high morale as well as delaying the enemy or even destroying an isolated detachment.

Control

38. ***Movement.*** Phase lines and report lines help to control movement. In the desert they are likely to be further apart than in central Europe and should be drawn along the most recognizable features available. Ease of recognition is more important than spacing the lines out evenly in places where they cannot be readily identified on the ground. A sound traffic control plan, implemented and signed by provost, is needed to move the force over as many practicable routes as possible, consistent with good going. All likely bottlenecks should be controlled by provost. Special arrangements must be made to recover breakdowns, extract bogged down vehicles from areas of soft sand which cannot be avoided, transfer loads from breakdowns and destroy non-runners which cannot be recovered.

39. ***Re-assembling Scattered Units.*** An organization is needed to re-assemble units and formations which have become dispersed during the withdrawal. It should be established behind the new main position and assembly areas should be allotted to each unit, using officers and NCOs at check points to recognize their men and vehicles as they drive through and guides and signs to direct them to the appropriate location. The echelons are likely to move separately under formation control. Special arrangements will be needed to guide them to a RV to rejoin and replenish their unit F echelons in their new locations.

CHAPTER 6

TRANSITIONAL PHASES

SECTION 1 - LINK-UP OPERATIONS

Circumstances

1. **Application to Desert Operations.** Because mobile operations in the desert are often so fluid, confusing and unpredictable, formations are apt to be cut off from the main body with little or no warning. The enemy will attempt to surround and destroy such isolated forces in the open before relief can arrive. Alternatively, a force may be hemmed in on terrain where it can be supplied by sea or air, or both. During a withdrawal a force may be left quite deliberately to hold a key position, such as a port, to threaten the enemy's communications, compelling him to divert forces to blockade it. Another scenario is a large-scale, two-pronged envelopment operation to cut off a sizeable element of the enemy or perhaps his entire force.
2. **The Problem.** The main difficulties in achieving a link-up in the desert are the enemy's ability to foresee the necessity for relieving a garrison or isolated force, the ease with which the approach of the relief force can be detected in such open country and, therefore, his ability to anticipate and thwart any moves. The nature of the desert itself makes for further problems in that it is not always easy to identify on the ground the place selected for the link-up and there are greater risks of shelling our own forces or attacking them from the air. In such circumstances the positive clearance of targets with both elements of the link-up becomes of even greater importance, first to prevent accidents and, second, to avoid giving the enemy an unlooked for immunity from artillery fire and air delivered weapons by allowing an undue margin of safety in the selection of a FSCL.

Planning

3. **Time Scale.** If the link-up is to be with a beleaguered force which is holding its own in relative security there will be time for detailed planning. When a force is cut off by the enemy in the middle of a mobile battle a link-up operation will have to be improvised in a hurry. In either case details must be passed to both forces involved in the link-up as early as possible consistent with security so that both elements have time to coordinate their plans, issue orders and take precautions to minimize the risk of friendly troops engaging each other, either with artillery or direct fire weapons.
4. **Coordination.** The main points to be considered at the planning stage are:
 - a. Axes of advance.
 - b. Link-up point.
 - c. Command.
 - d. Communications.

- e. Recognition between the link-up forces.
5. **Axes of Advance.** The choice of axis, or axes, if the force to be linked up with is also to attack, may be limited by the lie of the land, the going and the geographical position of the beleaguered force to only a few practicable approach routes. There may be scope for feints and diversions to divide the enemy's forces so that a battle may be sought on favourable terms. In a large scale envelopment operation the axes may be only a rough guide to planning, rather than a rigid instruction because the actual routes may have to be modified as the operation develops, the enemy reacts and areas of bad going are encountered.
 6. **Link-up Point.** To help both elements of the link-up forces in their planning and to lessen the risk of friendly troops firing on each other, it pays to arrange for the link-up to take place on some easily definable feature, such as a prominent track, an easily recognizable hill or escarpment or perhaps even a convenient tarmac road. If there is no such readily identifiable feature it may be wise to order each force to occupy neighbouring less prominent features from which they can establish contact at a distance instead of risking an engagement between friendly forces.
 7. **Command.** The same measures to clarify command relationships will be needed as in other environments. Initially, while the two forces are far apart, they will operate separately under the overall commander. When the forces approach each other the command arrangements will differ according to the nature of the link-up operation.
 - a. *Envelopment.* In the event of a large scale envelopment operation, in which the forces comprising the two prongs are roughly the same size, they are likely to remain directly under the overall commander right up to the link-up and beyond into the subsequent phases of reducing the trapped enemy, pursuing a retreating foe, mopping up disorganized elements or a combination of all three. In this instance the actions of the two enveloping forces are part of an overall operational concept and coordination and control are better exercised by the higher commander throughout.
 - b. *Relief of or Junction with a Smaller Force.* In these circumstances it will be necessary to lay down the arrangements for the smaller force to come under the command of the larger. Although the overall commander may have a specific time in mind for resupply as well as for operational planning purposes, in the fluid conditions of desert warfare he is more likely to reserve the decision until the forces approach to within artillery range of each other. Then he will issue the code word to implement the change of command.
 8. **Communications.** Common radio frequencies and codes to be used between the link-up forces must be issued to both elements. Ideally, the two forces should exchange liaison officers who should maintain constant touch on dedicated frequencies in addition to the higher command net linking the two forces. These measures are aimed at passing up-to-date information on progress and making arrangements for the link-up without breaching security.

9. **Recognition between Link-up Forces.** In the desert the dust raised by the movement of unidentified forces raises the observer's suspicions and his fears of being attacked. Because getting the first shot in, particularly by surprise, often confers a commanding advantage there is, perhaps, a greater risk in the desert than elsewhere of friendly link-up forces engaging each other at ranges and in light conditions where recognition is not easy. It is necessary to have as foolproof a mutual recognition system as possible. Ideally, radio contact between the two elements will have been achieved well before they come within sight of each other and they will aim to occupy adjacent features from where an exchange of recognition signals can be made. However, the radio may fail, messages may be delayed and the two friendly forces may make contact at an unexpected time and place. Coloured Verey light signals, coloured smoke or machine-gun tracer bursts fired vertically into the air in a distinctive pattern sequence offer alternative methods. A colour light and smoke code should be established for each day for the period of the battle and notified in advance to both elements. This not only ensures recognition whenever the link-up occurs, because planned timings may go awry, but also guards against compromise. Should an enemy counter-attack sever the link-up forces, an operation to re-establish contact at a later date will automatically use a different colour code.

Execution

10. **Effecting the Link-up.** As just mentioned, the plans for the link-up may not go according to schedule. One force may not be able to reach either the prominent landmark chosen as a contact point or one of the neighbouring features from which contact was to be established. It will be up to the initiative of the commander of the other force to press on until he makes contact. As the two sides draw close together the establishment of direct communications at lower formation and battle group level and the use of light signals will become even more important in an uncertain situation. Even with the latest night observation devices it is safer to arrange a link-up in daylight in the desert. However, if operational imperatives dictate a night rendezvous the risks will have to be accepted and minimized by reinsurance on the communication and visual signal arrangements described in the last paragraph.
11. **Fire Support**
- a. **Offensive Air Support.** To exploit offensive air support to the utmost without endangering one's own forces it is necessary to clear targets positively because reliance on a FSCL suffers from the disadvantages mentioned in paragraph 2. Air control teams, which are in close contact with the leading elements of the two forces involved in the link-up, must be deployed to ensure the safety of their own troops as well as accuracy of attack in featureless country.
 - b. **Artillery.** Radio contact must be established between the appropriate artillery headquarters, as well as the formation headquarters they support, to prevent accidents when the two forces come within gun and missile range of each other, as well as to provide mutual support.
12. **Combat Service Support.** A force which has been suddenly isolated in the desert may be dangerously short of supplies of all kinds when a link-up is finally achieved.

The staff of the relieving force must arrange for the rapid replenishment of such a force and should have a convoy of vehicles or helicopters, or both, ready to push through the gap once contact has been established.

13. **Traffic Control.** A traffic control organization must be set up not merely to prevent convoys and small groups of vehicles going astray in the advance to the link-up point but also to control traffic in the area where contact is made because the initial gap may be small. In the desert, the dust clouds of replenishment convoys can be seen for miles by enemy artillery OPs. The establishment of waiting areas so that vehicles can be halted, kept dispersed and trickled through the gap to reduce vulnerability will be an essential part of the link-up traffic control plan.

SECTION 2 - RELIEF IN PLACE

Circumstances

14. The circumstances in which a relief may take place are the same as for any other theatre except that the emphasis may be on the need to relieve forces which have suffered so heavily that they have to be withdrawn to recover their strength in men and equipment. The surviving troops will be available to reform the depleted units and formations and train them collectively.
15. It may not always be possible to relieve battered units and formations in the middle of a battle when every man, tank, IFV and APC counts. As a temporary expedient it may be necessary to amalgamate units and even formations. Provided that a common doctrine exists throughout the army this is a practicable proposition. The problem will be less one of how to operate than of establishing command and personal relationships in battle groups comprising men from many units. The rest of this section deals with a planned relief in which there is time for a proper handover.

Planning and Execution

16. **Security.** Formations and battle groups are particularly vulnerable during a relief when a large proportion of the force is exposed in the open, some bunching is inevitable and the two formations' command structures are changing over. Furthermore, the new formation will not be familiar with the ground. An enemy attack during a relief can cause immense dislocation in any environment but especially so in the desert where the incoming troops will find it more than usually difficult to orient themselves in featureless surroundings. Security is essential. The same level of patrolling, radio traffic and movement must be maintained for as long as possible.
17. **Protection.** If the risk of minor enemy interference is high, additional protective measures, such as ambushes on likely enemy fighting patrol routes, should be taken. If there is a risk of a major enemy attack the relief should be postponed.
18. **Liaison.** Small but carefully selected advanced parties should be sent up from the relieving battlegroups and formation headquarters to join their opposite numbers a few days before the relief to familiarize themselves with the situation, enemy habits and the ground. Battlegroup and squadron or company group OP parties should

spend at least a day in their new OPs before relief. Panoramas, sketches and range cards must be handed over to the incoming unit. The new battlegroup, squadron and company commanders should be given a chance to discuss the situation before handover. If it is not possible for the relieving units to send up advance parties, the units being relieved must leave rear parties to brief their opposite numbers in daylight. Strong engineer reconnaissance elements must accompany the advance party to familiarize themselves with the minefield layout and to take over the records and maps.

19. **Routes and Staging Areas.** As a relief in place is almost certain to be a night-time operation, routes must be allocated by the staff of the outgoing formation and marked and lit by the provost units of both formations. If possible, separate 'up' and 'down' routes should be allotted to the incoming and outgoing formations. To control movement and to prevent congestion, particularly at bottlenecks, staging areas should be designated as necessary. Traffic posts with recovery vehicles to winch out vehicles which become bogged down in soft sand, as well as to deal with vehicle casualties, should be set up on stretches of difficult going as well as at route junctions, turning off places, staging areas and at any place where drivers might miss their way.
20. **Phasing.** The headquarters under whose command both the relieved and the relieving formations come will decide whether the relief is to be carried out on one night or spread over several nights in order to avoid compromising security by the noise of too many vehicles moving at once and the dust clouds visible for miles in moonlight. Another decision will be required on whether to relieve battlegroups all along the front of a division simultaneously or whether to relieve one brigade at a time. If there is any risk of attack, having one forward formation intact and organized for defence will provide stability on at least half the divisional frontage.
21. **Timings.** The headquarters in overall command of the relief will lay down the key timings for the:
 - a. Move of reconnaissance and rear parties.
 - b. Start of the relief. This may be qualified by a moratorium on all movement before a certain hour. In the interests of security the moves 'up' and 'down' should be timed to coincide with routine replenishment.
 - c. Completion of the relief.
 - d. Change of command.
22. **Provision of Fire Support.** The formation in the line's artillery will provide fire support until the relieving formation has taken over its sector of the FLOT. The relieving formation's artillery will support the withdrawal of the outgoing formation. If possible the combat arms and artillery of the relieving formation should not be on the move at the same time, and vice versa. Because the location of the other side's gun positions is so easy in the desert it must be assumed that the enemy has pinpointed the outgoing formation's gun areas. Ideally, the incoming artillery should occupy different gun positions from the outgoing artillery in order to avoid counter-bombardment, at least

for a short period. It will be necessary to send the relieving artillery units' survey troops up with the regiments' advance parties at least a day before the relief in order to survey in the new gun positions accurately.

23. **Command.** Both the incoming and outgoing commanders should be collocated at the latter's headquarters during the relief. The timing of the change of command will be agreed on mutually between the outgoing and incoming commanders at each level, subject to the overall policy of the formation commander in charge of the entire relief. Troops of the outgoing battle groups and formations remaining in their old positions after the change of command will remain under the new commander for all purposes until they vacate their positions on relief.
24. **Communications.** If practicable, the outgoing formation's radio links and the usual voices should remain on the air until the end of the relief operation. By the time enemy SIGINT discovers the changes in voices and other idiosyncrasies the relief should have been completed.

CHAPTER 7

AIR AND AIR DEFENCE FACTORS

SECTION 1 - AIR FACTORS

1. ***Favourable Air Situation.*** Because of the lack of natural cover in the desert it is even more important to obtain and maintain a favourable air situation above own troops than it is in the wooded and built-up environment of central Europe. Without control of air space not only do forward troops become vulnerable to enemy air attack but artillery will be less able to support them. Resupply, casualty evacuation, recovery and repair will become increasingly difficult and the movement of reserves for counter-attack will be seriously inhibited. In the open desert this can result in the lack of ability to turn the tables in a defensive battle, let alone win an offensive one. A defender with inadequate air cover may be forced into a fatal dispersion which invites defeat in detail. In such an unfavourable air situation the only recourse may be a withdrawal to broken ground or into gebel where concealment is easier, the enemy's ground and airborne radar is degraded by screening and clutter and air attack is more difficult.
2. ***The Functions and Roles of Air Forces.*** All the functions and roles of air forces are the same in the desert as for elsewhere. The separate functions of reconnaissance, interdiction, close air support and air interdiction are the same. The methods by which these functions are controlled by the air force and further reference to the control and use of air forces for land operations is given in AFM Vol I¹. The only significant differences in the method of air operations in the desert and elsewhere is the climatic conditions which can affect air operations directly. There can be occasions when it is too hot to fly - particularly during the middle of the day. Airframes become intolerably hot, air coolants cannot function properly and it can be unsafe to fly. For helicopter operations this can also affect the "lift capacity" adversely which can have a significant effect on their capacity to operate. Beyond this routine aircraft and helicopter maintenance in the sand and dust conditions is significantly more difficult to achieve and this could affect operational readiness and the availability of aircraft for use.
3. ***Command of Air Forces.*** Air forces in support of land operations will normally be controlled at the highest possible level, usually by the Air Support Operations Centre (ASOC) at force headquarters², whether that be the equivalent of an army or a corps. Centralized control exploits the flexibility of air power, enabling it to be concentrated in time and space to the best advantage. However, in certain circumstances, control of a portion of the air effort may be delegated to a lower formation for a particular task within specific time limits. Indeed, such delegation is essential if the response to requests is to be sufficiently quick.

1. The specific publications are AFM Vol 1 Pt 1 *Formation Tactics* and AFM Vol 1 Pt 2 *Battlegroup Tactics*.

2. The ASOC will probably be split into two cells, one dealing with offensive support (ASOC(OS)) at main headquarters and the other dealing with helicopter support (ASOC(SH)) at rear headquarters. RAF advisors will be needed at division and brigade HQs (DALO and BALO).

SECTION 2 - CONTROL, SAFETY AND TARGET IDENTIFICATION

4. **Identification of Friendly Forward Troops.** The desert appears even more featureless to a pilot than to the soldier on the ground. At the speed aircraft travel it is difficult to recognize equipment and to tell friend from foe in mobile operations, especially on a battlefield cluttered with disabled tanks and vehicles shrouded in clouds of dust and perhaps obscured by palls of black smoke from burning oil installations. Fluorescent panels are useful for identifying the position of forward troops. If control of the airspace is certain it may be possible to display them all day, provided that they are hidden from enemy ground observation. In an adverse air situation it may only be possible to display panels just before friendly aircraft arrive to make an attack. As a further aid to identification distinctive markings can be painted on or fixed to vehicle roofs. In a static situation transponders or beacons broadcasting an electronic signal which a friendly aircraft can pick up on its navigation or audio system may be used to give pilots a general idea of where forward troops are located.

5. **Positive Control and Target Indication.** In the desert, where it is difficult for pilots to discriminate between enemy targets and our own positions, it is necessary to use a positive clearance system for close air support missions. While previously agreed and promulgated plans and orders form a controlling framework they are apt to impose undesirable limitations in terms of timeliness and flexibility. Positive clearance must be obtained from those units which might be at risk from friendly attack. Each formation and battle group is responsible for the positive control of fire brought down within the area it currently influences. In addition, should a formation or battle group wish to engage a target on or dangerously close to its boundary it must obtain clearance from its neighbour. The following means of exercising control and aids for marking targets are available:
 - a. **FAC and Laser Designator.** The optimum method for controlling attacks on pinpoint targets is a combination of a forward air controller (FAC) using ground-to-air radio and a laser designator. Used by field artillery OPs, the latter is invaluable for identifying targets to fighter-ground attack pilots. Dedicated communications to notify the FAC, supporting artillery and own troops in the FEBA of the ETA of the aircraft are essential to coordinate target marking, suppress enemy anti-aircraft fire, minimize the danger to aircraft of flying through the trajectory of shells and provide for the safety of forward troops.

 - b. **Airborne FAC.** If the air situation permits, an airborne FAC, flying out of range of the enemy's air defence weapons and sufficiently high to obtain a good view of the battlefield, can describe the ground and landmarks from the perspective of the close air support pilot. Changes in the desert's colour and texture are often more apparent from the air than from the ground. When a laser designator cannot be used an airborne FAC can point out the target and the locations of our own troops in a way the close air support pilot can readily recognize.

 - c. **Coloured Smoke and Illumination Rounds.** Artillery and mortar coloured smoke, white phosphorous and illumination rounds set for low airburst may be used to mark targets or to act as reference points in featureless terrain. However, as there is usually a stiff breeze in the desert smoke ammunition expenditure rates may be uneconomically high.

- d. *Panels.* Fluorescent panels, laid out in a V pointing towards the target, with other panels laid behind the letter to indicate an approximate range in units of 500 metres, may serve in an emergency.
 - e. *Artificial Landmarks.* While aircraft use their own navigational aids to reach the battle zone, artificial landmarks are invaluable in the absence of prominent natural features to orient the pilot and provide a reference point from which the FAC can direct pilots to the target area.
6. ***Fire Control Lines.*** In the concept of three dimensional deep, close and rear operations, especially in the featureless desert, the use of lines such as the restricted fire line (RFL), the battlefield coordination line (BCL) and the fire support coordination line (FSCL) are of declining utility. In any case, a lack of easily recognizable features, small scale maps and incomplete survey may oblige the joint ground and air operations staffs to choose a line further away from the FLOT than would be normal in north-west Europe to avoid the risk of air attacks on friendly troops. Reliance must be placed in the positive clearance system described in the previous paragraph. Attacks which are beyond the FAC's range of control may be made in safety if the close air support mission leader checks with the brigade or division air liaison officer that there has been no significant change in the situation since the request was made and that he is satisfied that there is no danger to our own troops.
7. ***Safety of Friendly Aircraft.*** Just as it is important to safeguard the troops on our FLOT from attack by friendly aircraft by mistake so, too, it is necessary to avoid unnecessary casualties to our aircraft from friendly ground fire, particularly in an unfavourable air situation when soldiers who have suffered enemy air attack are liable to shoot at any aircraft. The problem is the difficulty of recognising friend from foe in the context of the short engagement times against high speed aircraft. While IFF systems provide a speedy challenge and response for artillery air defence units, other arms can only rely on observation, aircraft recognition and aircraft behaviour. They have to make a split second decision on whether or not to open fire. The safest measure is to route outgoing and incoming aircraft round an open flank or over the sea. In the absence of a convenient flank, air corridors, in which ground forces will not open fire on aircraft unless they behave in a hostile manner, may provide the most practical solution in the open desert. Artificial landmarks may have to be constructed to help pilots to recognize them. However, when air support is required in areas away from the corridors aircraft safety may have to depend entirely on aircraft behaviour, the way in which pilots make their attacks and return over our lines, and on notification of their ETAs to the forward troops.

SECTION 3 - AIR DEFENCE

8. ***Air Defence: Scale and Priorities.*** A combination of area and point defence guided weapons systems, thickened up with machine-guns mounted on APCs, IFVs and soft-skinned vehicles provide a defence and a deterrent to air attack. Because of the openness of the terrain and the vulnerability of ground forces a higher proportion of area and point air defence systems will be needed than in central Europe. The greater the enemy air threat the more air defence artillery will be required to avert the potentially disastrous consequences of air inferiority in the desert. Even so, there are

unlikely ever to be enough guided weapon launchers and an opponent who has air superiority may have the technical ability to counter them. Formation air defence plans must establish priorities for the protection of their most essential and vulnerable elements for each phase of a battle. They must also provide continuous cover during an attack, an advance or a pursuit, as well as over a defensive position and counterstroke forces, to avoid exposing unprotected troops to needless casualties and, perhaps, defeat. The air defence plan must be made jointly with the air force to ensure the coordination of the air superiority operation as a whole, as well as the safety of our own aircraft. This involves the normal air space management for controlling air defence weapons (weapons unlimited, weapons free, weapons tight or weapons held) and safe lanes.

9. ***Application of Air Defence Principles.***

- a. *Concentration.* The most important principles in the deployment of air defence resources are mass and integration. The temptation to disperse the system to give everyone a degree of protection will result in an ineffective defence. The advantages of concentrating the air defence system, combining area and point weapons to give an effective umbrella with two layers of protection, can be exploited tactically. Units and formations concentrating for security from air attack under the air defence umbrella will be able to avoid a dangerous degree of tactical dispersion.
- b. *Air Defence in an Unfavourable Air Situation.* However, a concentration of air defences in a particular area may signal a commander's intentions to the enemy. The risk is particularly acute when fighting a defensive battle in an unfavourable air situation. The concealment of the axis of a vital countermove on which the outcome may depend will place a commander in the dilemma of whether to go for protection or surprise. Ideally, the force should be despatched to the theatre with the extra air defences to provide sufficient protection on an area basis. As this may not be possible it may be necessary to resort to deception and a redeployment of air defence weapons to preselected sites at the last minute. If, in a countermove the leading elements are able to penetrate the enemy's attacking forces in depth they may be able to create sufficient confusion to inhibit the enemy's ability to exploit his advantage in numbers of attack aircraft and armed helicopters for a critical period.
- c. *Flat Desert Terrain.* The lower and less cluttered air defence radar horizons in the open desert enable enemy aircraft to be acquired and engaged at longer ranges, offering a combination of better protection and the infliction of a higher rate of attrition than an enemy air force can sustain. However, there is the associated problem in flat terrain that a friendly response from an IFF radar side lobe can cause an operator to think that an enemy aircraft approaching head-on is friendly.
- d. *Priorities.* Defensive positions, gun areas and CSS facilities will normally be high on formation air defence priority lists. Headquarters can be sited within the air defence envelope and should be given point defence protection in addition.

- e. *Light Air Defence Weapons.* Because air defence systems can be saturated and decoyed, vehicle-mounted machine guns and hand-held launchers play an important role in boosting the system as a whole and promoting troop morale in an unfavourable air situation. Even so, only some enemy low level systems will be deterred because the more sophisticated air-to-ground weapons can be launched from aircraft outside the range of low level air defence weapons.
10. **Action on Enemy Air Attack.** Logistic installations derive benefit from the depth of the air force radar coverage and are able to organize warning systems to caution men to take cover and alert designated launchers and automatic weapons for quick reaction. In forward areas, where attacks may develop in a split second, formation and unit SOPs will lay down the action to be taken by troops mounted in vehicles and on the move when attacked from the air. Much will depend on the seriousness of the threat.
- a. *Light Attack.* If the attack is a minor or sporadic one and the going is good and fast it may be possible to continue the move, the vehicles speeding up and swerving, except for those belonging to air defence missile detachments, which will halt and go into action. An effective tactic for a lone vehicle singled out for attack is to drive fast towards the approaching aircraft, forcing the pilot into the danger of steepening his angle of attack, and then to swerve 30 degrees to one side when it is estimated that the pilot is about to fire his missiles or cannon.
 - b. *Heavy Attack.* In the face of a serious attack a column should stop, troops in soft-skinned or lightly armoured vehicles dismount and move well away from them while every air defence weapon is brought to bear on the enemy aircraft. This includes the pintle-mounted machine guns on armoured vehicles, whose gunners should remain at their posts. Armoured vehicles may fire their smoke dischargers to confuse the pilot, provided napalm is not being used. In the event of a napalm attack tank crews should close down and switch off their engines to avoid ingesting napalm through their air intakes. The dismounted troops' light machine-guns should be used to thicken up the fire. Although air defence missiles may take a greater toll of enemy aircraft, the sheer volume of tracer may distract the enemy pilots and weaken their resolve to press their attacks home. Even if an aircraft is not brought down, some damage may be inflicted although this may not be apparent to the machine-gunner. Even a solitary bullet hole has to be examined by ground crew on return to base to make sure that nothing vital has been hit, thus denying the enemy the use of an aircraft temporarily when every sortie may count.
 - c. *Armed/Attack Helicopter Threat.* The armed helicopter is likely to prove a greater threat than the fighter-ground attack aircraft in a war against a first class enemy. At the ranges they may engage our forces, only longer range air defence weapons such as HVM are likely to be effective. However, it may take a friendly armed helicopter to deal with a similar enemy weapon system because, in the extended ranges of desert warfare, the enemy pilot will be able to keep below our air defence missile envelope. The advent of the helicopter masthead sight and the jam-proof fibre-optic-guided non-line-of-sight (NLOS) missile may help our own armed helicopters to reduce the enemy armed helicopter threat in the

open terrain of the desert. Without such protection our troops may be very vulnerable in the forward areas.

SECTION 4 - HELICOPTERS

Armed/Attack Helicopters

11. **Characteristics of Employment.** The long ranges and good visibility associated with the desert, at least until tracks and shell bursts stir up the sand, enhance the value of the armed or attack helicopter, adding to its already formidable potential as a major destroyer of enemy armour. In the context of a fast moving battle fought over a wide area of desert the aviation regiment provides valuable firepower which can be switched round the battlefield in effective concentrations with relative ease and speed. Because army aviation is organic to formations, helicopter support may well be provided more quickly and more easily than close air support but this will depend on many factors. Pilots of armed/attack helicopter pilots may have the advantages of knowing the units they are supporting and being acquainted with the ground. Because the FSCL is likely to be much further away from the FLOT this local familiarity will be particularly valuable in dealing with enemy armour in a confused situation when the opposing forces are intermingled and where clouds of dust may obscure much of the battlefield as the action develops. Armed/attack helicopters can be deployed in a variety of ways depending upon the task. For counter-penetration operations the concentration of fire teams in time or space may give the best results but, for offensive operations, intimate armed reconnaissance patrols may offer the most effective way of allocating aviation resources.
12. **Target Priorities.** The formation commander will specify target priorities for each phase of a battle. While enemy armour may be the most important target, priority will usually have to be given to enemy weapon systems which pose a threat to friendly force aircraft and jeopardize the success of an operation, particularly in the open desert. Provided that it is possible to locate, identify and recognize specific types of enemy equipment, the order of priority may be:
 - a. Air defence systems (radar, missiles and guns) which have not been suppressed by artillery fire.
 - b. Command and support tanks used for the control of artillery and fighter-ground attack.
 - c. Command tanks and APCs or IFVs.
 - d. Remaining tanks.
 - e. Engineer vehicles breaching obstacles.
 - f. Artillery, provided that it can be engaged without unnecessarily risking the attacking aircraft.

13. ***Control of Armed/Attack Helicopters.*** The aviation regimental liaison officers attached to formation headquarters will be responsible for advising the staff on the use of anti-tank and attack helicopters, tasking the attack missions and arranging for suppressive artillery fire on known enemy positions and weapons which pose a threat. In the desert, reconnaissance helicopters are in a good position to locate targets from above the level of the heat haze. Because of the lack of covered approaches in flat terrain it is essential to coordinate the suppressive fire effort to force enemy armour in the area to close down and to neutralize hostile air defences before the arrival of the helicopters at the predetermined RV. The reconnaissance helicopters must maintain contact with the enemy in order to achieve this. They must also brief the mission commander and crews of the latter on the position of targets and advise them on the best approaches from the points of view of terrain cover and the avoidance of soft sand where their rotors may stir up give-away dust clouds. The squadron commander will normally coordinate an attack in a brigade area, making use of the information provided by his reconnaissance helicopters and the up-to-date picture of the tactical situation painted by the liaison officer at brigade headquarters. Only in static positions is the enemy likely to present an unbroken line of air defence. In a mobile battle wide gaps open up enabling reconnaissance and armed helicopters to exploit them to engage the enemy from unexpected directions. It is the task of reconnaissance helicopters to find and probe these gaps.
14. ***Factors Affecting the Operation of Armed/Attack Helicopters.*** Much care must be taken in the desert to provide good terrain screening for landing sites and to reduce the dust problem with membranes, mats or treatment with oil. While the latter method is the most efficacious it leaves a prominent dark stain, visible to enemy air reconnaissance, drones and satellites. Covered approaches to forward RVs and engagement areas are essential because flying nap-of-the-earth in the open can raise a distinctive dust signature which can be spotted 20 km away. Although a low speed of only 15 knots (about 18 mph) is sufficient to reduce the dust signature, pilots en route to the target will be aware of the need to avoid the risks of loitering. Ideally, targets should be attacked from an open flank, using terrain cover, downsun to aid sighting and to blind the enemy and from upwind to avoid dust obscuration at the target. In the desert, armed helicopters, as opposed to attack helicopters, will be forced to operate behind the FLOT. Although armour can be caught unawares by attack from an unexpected direction because tank crews closed down cannot see well, let alone hear an approaching attack helicopter, static positions are hard to surprise because their sentries have all round vision and can pick up the engine and rotor noise. Because it is usually necessary to camouflage helicopters waiting on a landing site in the open desert, formation and unit headquarters must pay particular attention to their helicopter planning states.

Air Mobility

15. The desert offers scope for air mobile and airborne operations round open flanks to seize important features in the enemy's rear, such as passes through gebel and gaps through escarpments, sand seas, sebkha or depressions. At the end of a successful campaign in particular, when the enemy's resistance has been broken, airborne or helicopter-borne forces may be used to stake out territory for use as a bargaining counter in peace negotiations. As forces dropped by parachute or delivered by

helicopter are likely to be relatively small, lack the ability to take on armour in the open and be restricted in the artillery they can take with them, they should be dropped on hilly or broken ground where infantry with hand held anti-tank weapons can sustain a defence until link-up. The main ingredients for success are a favourable air situation, surprise and speed of link-up with the main forces. Such operations may be mounted to cut off a retreating enemy or to block an enemy counter-attack route where broken country limits the enemy's choice of axes.

16. The main problems are likely to be:

- a. *Achieving Surprise.* Operational surprise will be obtained by good security, striking in an unexpected location and deception. Tactical surprise may be obtained by using approaches covered from enemy observation and surveillance radars. Where gorges or escarpments provide good terrain cover there is no problem. In flat, featureless desert there are usually folds in the ground which can be exploited but they are difficult to find. In deserts which are well surveyed routes can be picked off the map although it may be advisable to check them by reconnaissance. In poorly surveyed deserts prior reconnaissance is essential but it needs to be undertaken discreetly to avoid forfeiting surprise. Otherwise insertion may only be possible at night provided that there is sufficient moonlight to make possible a low level approach by aircraft or nap-of-earth flying by helicopters. In the latter case helicopters must fly just high enough to avoid raising tell-tale clouds of dust which will not only alert the enemy but interfere with the vision of pilots flying at the rear of the stream.
- b. *Avoiding Enemy SAM Defences.* Although more difficult in the desert, this can be achieved by careful routing and suppressing the enemy's search and fire control radars. In the exploitation of success the enemy's SAM system may be disorganized and gaps may have been found by reconnaissance or ECM aircraft. Once an enemy position has been broken through and the cohesion of its air defence system destroyed, armed and transport helicopters, the latter carrying infantry accompanied by anti-tank weapons, FOOs and FACs, can follow on the heels of the armoured spearhead to seize vital ground, especially defensible defiles, deeper in the enemy's rear than in a European environment.
- c. *Compromise between Size of Force and Available Lift.* Ideally, the whole force should be delivered in one lift. This provides the best chance of combining surprise and concentration of effort, especially in the desert where it is hard to conceal such an operation. Whether two or more lifts are used to deliver a larger force will depend on the intelligence assessment of the enemy's ability to interdict the air route and the enemy's likely speed and size of reaction against the dropping zone. These considerations affect the decision whether to land a smaller force complete with sufficient ammunition, water and rations to last until link-up or whether to land a larger combat force initially and build up supplies in subsequent lifts. The optimum balance can only be assessed at the time.
- d. *Command and Fire Support.* A decision will be required as to the moment that command of the air-delivered force passes from the headquarters which launched the operation to the headquarters of the ground link-up force. Commu-

nications must be arranged so that the air-delivered force can call for close air support initially and artillery support from the link-up force as soon as the latter comes within range.

- e. *Air Defence.* The air-delivered force needs its own air defence weapons, especially if dropped beyond the friendly SAM envelope in open terrain. Special care must be taken to prevent engaging our own aircraft by mistake.

Liaison and Casevac

17. Although invaluable for liaison, the movement round the battlefield of commanders, the assembly of 'O' groups and casevac, helicopters are vulnerable in the open desert. When there is no terrain cover helicopters may only be able to operate in the forward areas at night using LZs with masked directional lights. Even where there is cover from direct observation it will be necessary to select LZs with a view to exploiting covered approaches, preferably from more than one direction and treating them as described in paragraph 17 above to reduce the dust signature. Where this is not possible the dust hazard may be reduced by running take offs and landings and not hovering close to the ground. LZs should be positioned downwind of headquarters and installations to further reduce the dust nuisance. If a helicopter is to remain on the ground for any length of time it should be camouflaged and its perspex surfaces covered by mats.

CHAPTER 8

THE COMBAT AND COMBAT SUPPORT ARMS

SECTION 1 - COMBAT ARMS

Armoured Reconnaissance

1. **Command and Control.** The pros and cons of centralizing control of the covering force under one formation headquarters or allowing each forward formation to control the elements of it within its own sector are discussed elsewhere. Because medium reconnaissance, whether obtained from armoured reconnaissance vehicles or helicopters, provides so much information for the engagement of targets by artillery, armed helicopter or the air force it may be convenient to group all the resources belonging to a formation under the senior artillery officer.
2. **Air Defence.** The armoured reconnaissance regiments on the covering force's screen will need their own point air defence because it is likely to be deployed at or near the limits of the main position's area air defence, especially in the low level envelope. However, it will be virtually impossible to provide a guaranteed close air defence for all the elements of a screen.
3. **Stealth versus Gaining Information.** Because reconnaissance vehicles are only lightly armoured and armed they and their crews have to depend on stealth, concealment and well camouflaged static OPs. Special vehicle paints, yellow or pink and rubberised coatings to degrade enemy infra-red devices may be useful. Only passive surveillance devices should be used by the screen in contact with the enemy. Active sensors and bad concealment lead to discovery and destruction. Because of their vulnerability reconnaissance units should be withdrawn from the contact battle once enemy tanks have been encountered. If it is necessary to fight for information the task should be given to a battle group, preferably an armour-heavy one.
4. **Light Anti-Armour Capability.** In terrain which provides cover from view and hidden approaches, anti-tank guided weapons, mounted on light vehicles with good cross-country mobility, may, in conjunction with armed helicopters, offer a measure of resistance, or at least impose significant delay, on enemy armour. The accent will be on exploiting mobility to surprise enemy tanks from defiladed fire positions and then to 'shoot and scoot'.

Armour

5. **Concentration.** Although the advantages of using armour in sufficient concentrations to obtain a decision has already been mentioned they bear repeating. Whether in attack or defence, armour should operate in the largest concentration possible but without crowding together to offer a vulnerable target. It must also retain its mobility if it is to be able to move to counter a developing threat or to exploit success. As little as possible should be tied down supporting defensive positions. If a superior armoured force is to be split to make a double envelopment attack the risk that the enemy may hold off one thrust sufficiently long to concentrate on and beat the other

must be weighed carefully. At the other end of the scale the squadron should be kept together as the basic fighting entity.

6. ***Firepower, Protection and Agility.*** In the open desert targets will be acquired at a greater range than in central Europe and massed target arrays may be exposed for longer periods. Commanders may be tempted to open engagements at too great a range when accuracy and lethality are significantly reduced. A balance must be struck between the need to open up at long range to cope with the number of targets and the need to hold fire in order to maximise surprise and conserve ammunition. HESH is a useful long range weapon against soft area targets but a gun with the range, accuracy and lethality to destroy hostile tanks at a greater range than can the enemy is the prime prerequisite of a tank. Next come armour and survivability because tank crews feel particularly vulnerable in the desert. Speed and agility are also important to move rapidly between the longer bounds prevalent in the desert or to dodge behind cover. Ideally, tanks should move from cover to cover in short, 15 second bounds to avoid presenting the anti-tank guided weapon operator with an easy target. However, tanks are exposed for longer periods in the desert than elsewhere so that speed and agility may be less important to crew survivability than armour. Ideally, no unnecessary attachments or kit should be fastened to the outside of a tank which might catch fire or act as a projectile when struck by a splinter or blast, to wound or kill the tank commander who may have his head out of the turret. In defence, the ability of the dug-in, hull down tank to hold ground should not be underestimated, particularly as infantry are vulnerable in the open desert. Tanks may use semi-indirect/high ellipse fire to good effect. Indirect fire is no longer taught. However, should a desert campaign continue for some time it may pay to train crews in the technique so that tanks not engaged on the FLOT could be used to provide indirect support against area targets using HESH.
7. ***Gunnery.*** The importance of being able to achieve a first round 'kill' at long range cannot be overstressed. While all tank crews should be trained to an equal standard of competence it is recognised that battle casualty replacements may not be capable of achieving such high standards until they acquire the skill and confidence that come with battle experience. In such circumstances it may be worth using particularly skilful crews as sniping tanks. Another essential skill is the ability to engage targets in different directions rapidly. This facility is especially useful in the dust and confusion of a close range battle when enemy tanks appear suddenly from unexpected quarters. When muzzle blast raises huge clouds of dust tank commanders within a troop may usefully spot and correct each other's fire in addition to watching for and giving warnings of unexpected threats. Of the other gunnery problems facing the tank the main ones are the adverse effect of blown sand on lasers, which emphasises the advantages of stadiametric range-finders, the heat shimmer which degrades boresighting and the gunner's lay, and the difficulty of range estimation. Hopefully, in future conflicts there will be time to learn how to allow or compensate for these problems during training before committal to battle.
8. ***All-round Vision and Awareness.*** The ability to beat the enemy to the draw and the need for quickness to spot threats from hostile tanks, armed helicopters and anti-tank guided weapons in a confused situation require that the tank commander be constantly aware of the situation around him. Although tank turret periscopes give an

all-round view it is necessarily a restricted one. This is a serious disadvantage in the desert where threats can materialize unexpectedly from any direction. With his head out of the turret a tank commander has a greater awareness of the situation and can react much quicker than when closed down. However, a 'heads-up' policy is expensive in tank commanders. Regimental commanders will doubtless have their own policies which they will review in the light of battle experience.

Infantry

9. Armoured Infantry.

- a. Only armoured infantry, whose IFVs have the same tactical mobility as the tank and offer some armoured protection and organic firepower, can operate in the open desert in conjunction with armour. The mechanized infantryman's APC no longer has the same mobility as the tank. In the attack armoured infantry will accompany the leading tanks to seize, occupy and consolidate ground on the heels of supporting artillery fire.
- b. Armoured infantry will normally use its IFVs to provide additional fire support for its dismounted infantry in the attack during the fight through the objective. In defence the IFVs will usually be sited within their respective company defensive areas in accordance with their companies' missions but in such a way as to make the maximum use of the range of their vehicle mounted weapons to destroy enemy IFVs or APCs, preferably while the enemy infantry is still mounted, and to provide extra fire support.
- c. If defensive positions are to be occupied for any length of time the infantry will require a considerable quantity of defence stores to revet fire trenches, provide overhead protection, and construct heavy weapon positions and shelters. Fire trenches should be constructed flush with the ground, as narrow as possible and, in the absence of revetting material, faced with rocks if available. Sandbags are useful for reducing the incidence of rock splinters from ricochets and shell bursts, a major cause of eye wounds in the desert.
- d. If an armoured formation is obliged to remain static in very open desert it may not be possible to dig the infantry in with the forward tanks. It may be necessary to hold the front with armour, using such cover and undulations as are available to enable tanks to occupy hull down positions, and to hold the infantry a tactical bound further back. Depending on the situation, the infantry could either move forward to temporary positions at night to give the tanks local protection and cover replenishment or the tanks could move back behind the infantry screen at last light, either as a body or individually, to replenish. However, if the armour is withdrawn as a body repeatedly as a matter of routine the enemy may take advantage of the habit.
- e. Dug-in ATGW firers with a line of sight to target only 2 or 3 feet above the ground will be especially prone to heat haze obscuration. Where possible they should seek positions providing a line of sight some 6 feet above the level of the intervening ground, being careful to select sites which offer defilade. In open

desert the shoulders of rising ground should be used rather than obvious hilltops. Weapon operators should also appreciate the need to minimize the weapon signature in such a dusty environment.

10. **Airportable Infantry.** There is no place for airportable infantry in the open desert. It is too vulnerable and it lacks the mobility and protection provided by the IFV. It is no solution to dig infantry in on the open desert and surround them with minefields and barbed wire. Such infantry can be bypassed and become a hostage to enemy armoured formations should they win the armoured battle. Attempts to relieve them are likely to be at the expense of further heavy casualties amongst our depleted armoured forces¹. Airportable infantry can only be employed in ground unsuitable for armour, such as gebel or behind sebkha, or to defend broken ground when both flanks are secured by impassable obstacles. Airmobile or air assault infantry may be used to seize defiles ahead of the main forces in rugged gebel terrain where they can hold out long enough to be relieved by armoured forces. Airportable infantry are invaluable for rounding up and guarding prisoners of war to release armoured infantry for their mobile role.
11. **Grouping.** As for armour, infantry should not be employed in less than company strength, together with a company's normal allocation of support weapons, for both tactical and logistic reasons. The firepower of a complete battalion represents more than just the total of its companies and their affiliated support.

SECTION 2 - COMBAT SUPPORT ARMS

Artillery

12. **Roles and Principles of Employment.** These are the same as for warfare in Europe. In medium paced operations over the frontages associated with desert warfare it may be possible to plan for the leapfrogging of batteries to ensure continuous support and having sufficient guns or rocket launchers in action at any one time to produce an effective concentration of fire. In fast moving operations over long distances, especially in a rapid advance, leapfrogging may be impracticable. It will be necessary

1. At the Battle of Gazala in May and June 1942, Auchinleck imposed on Ritchie his concept of using the brigade group rather than the division as the main tactical formation. A series of brigade boxes, wired in and mined, from 1st South African Division, 50th Infantry Division, 10th Indian Infantry Division and a number of independent brigades stretched in an over-extended arc from Gazala via Bir Hacheim to Bir Gubi to protect the administrative echelons and No 4 Forward Base east of El Adem. They were incapable of providing a framework within which our armour could counter Rommel's Deutsches Afrika Korps. Having lost the armoured battle and four of the infantry brigades the remainder were withdrawn, battered and in some confusion. 2nd South African Infantry Division, trapped in Tobruk, was forced to surrender. Earlier, Auchinleck had made the point in a signal in reply to one from Churchill, pressing for offensive action, when he took over the Middle East command, 'It is quite clear to me that infantry divisions however well trained and equipped are no good for offensive operations in this terrain against enemy armoured forces. Infantry divisions are and will be needed to hold defended localities and to capture enemy-defended localities after enemy armoured forces have been neutralized or destroyed, but the main offensive must be carried out by armoured formations supported by motorized formations.' John Connell, *Auchinleck, A Critical Biography*, Cassell, 1959, page 252 paragraph 9. One might add that motorized formations are now equally vulnerable and that airportable infantry can only hold ground which is sufficiently broken to offer an obstacle to armour and from which the enemy can only evict them with difficulty.

for batteries to keep on the move behind the main battlegroups until they are required to provide fire support and deploy rapidly into action off the line of march. It will be up to the operational commander to decide where the main artillery effort is required and the artillery commanders and staffs to plan the move and deployment of regiments and batteries to provide the necessary support.

13. **Concentration of Fire.** The lack of concealment in the open desert and the ease with which a first-class enemy can pinpoint gun positions by locating devices, including drones and air reconnaissance, may oblige us to disperse our gun positions to take advantage of such cover which minor folds of the ground and wadis offer. The temptation, so easy to succumb to in the desert, to disperse fire in ineffectual penny packets must be resisted. All artillery must be commanded at the highest level. The long fields of view combined with modern fire control, surveillance and communication systems facilitate the dispersion of gun positions without reducing the capacity to concentrate and switch fire rapidly and effectively against targets in succession. Concentrated artillery fire not only has a pulverising and demoralizing effect. It raises huge, dense clouds of dust which drift for miles in the wind, so thick that the enemy becomes disorientated and incapable of effective mutual support. By the same token enemy artillery concentrations can produce a similar effect on our own troops and it is necessary to site OPs, observation devices and radars as widely spaced as possible, in terms of both frontage and depth, so that not all are blinded simultaneously.

14. **Target Priorities.** The greater range and effectiveness of modern surveillance and artillery, especially MLRS, can best be exploited by grouping the medium reconnaissance effort, tracked, helicopter and drone, together with the artillery, under one commander. In a formation, the senior artillery officer provides the best focal point because satellite information is also readily available at that level and the close air support effort can readily be coordinated with artillery fire for both close and deep operations. The direct support regiments will normally support the brigade contact battle while the general support group engages targets further out. As explained in Chapter 7 in connection with offensive air support the control of fire support in simultaneous deep, close and rear operations requires both procedural and positive control. While procedural methods, such as orders and SOPs, form a basis for control they suffer the disadvantage of inflexibility in terms of quick reaction to an unexpected setback or opportunity.² It is, therefore, necessary to obtain positive clearance from all those who may be affected by the engagement of a particular target. It follows that formations and battle groups should assume responsibility for the positive control of fire against targets within the area which they currently influence. These areas need defining and disseminating in real time, and should take account of the air space above them as well as breadth and depth.

2. The linear control measures used at the time of Operation *Desert Storm* are now declining in usefulness. As a matter of historical interest, deconfliction between the contact and depth battle was achieved by establishing a restricted fire line (RFL) between the two. Further out still, a battle coordination line (BCL) separated the area of responsibility between division and corps. During 1st Armoured Division's advance the BCL was established between 20-40 kilometres in front of the RFL and the FSCL roughly the same distance beyond the BCL.

15. **Defence.** The need for all-round defence in the desert places artillery in a dilemma. Those artillery weapons which have an anti-tank capability should carry a proportion of smoke rounds for protection against enemy armour. However, it must be clearly understood that a gun's anti-tank capability is designed solely to give field artillery a defensive capability in a dire emergency. Artillery should not be deployed in an anti-tank role. It should be located in as secure an area as possible because its diversion on anti-tank tasks can only be at the expense of its primary role, which is to destroy and neutralize the enemy as part of the design for the all arms battle. Deprived of this support armour and infantry may well be defeated, the guns overrun and the battle lost. While self-propelled artillery offers some protection for its detachments and enables them to move quickly to avoid enemy counter-battery fire, this mobility carries a logistic penalty.
16. **Dumping.** Forward dumping on a large scale may not always be feasible. An increased number of high mobility load carriers and ammunition handling equipment will be required both to keep up with the guns during the constant redeployments of a mobile desert battle and to provide for the heavy expenditure of larger calibre ammunition.
17. **Calibre.** The experience of recent desert wars indicates a minimum calibre requirement for 155mm calibre artillery for field regiments. The weight of shell and increased range give current 155mm guns an immense advantage over other calibres in the wider frontages of desert warfare. MLRS, using a combination of target acquisition and independently homing warheads, enables enemy reserves to be engaged in depth in their concentration areas and on the move to launch an attack or counterstroke. Sub-munitions are more effective than normal artillery shells.
18. **Survey and Location.** Unless the existing theatre maps are accurate there will be a requirement for the quick and precise survey of gun positions and for the selection and survey of alternative ones. The problem will be compounded by the need for dispersed gun positions and for the selection and survey of alternative ones. GPS can be used to survey in gun positions and OPs. From the latter, laser range finders will give a precise bearing and distance to targets so that the enemy may be engaged accurately with the opening rounds of a shoot to achieve the maximum of surprise and effect with the minimum expenditure of ammunition. Deserts are a favourable environment for locating enemy gun positions but, again, exact survey is essential. Similarly, up-to-date meteorological data in an environment subject to extremes of temperature and high winds but often lacking in local meteorological stations is as necessary as good survey if ammunition is not to be wasted and our own troops' safety endangered.
19. **Air Defence.** See Section 3 of Chapter 7.

Engineers

20. **Counter Mobility.** Obstacle planning should take account of the following factors:
 - a. Obstacles are most effective in areas where they cannot be easily bypassed, eg, in defiles through escarpments and ridges or between the sea and a natural

barrier such as a marshy depression. Scarping steep, low hills and excavating anti-tank ditches provide useful obstacles, particularly when reinforced by anti-tank and anti-personnel mines, in addition to being covered by fire.

- b. In the open desert it may be necessary to construct some artificial obstacles to assist in the protection of key terrain, even though they may be bypassed. The successful defence of such localities will be dependent on aggressive action to regain the initiative and relieve their garrisons in the process.
 - c. Extensive barriers may be used to force the enemy into making a wide outflanking move in order to render him vulnerable to a counterstroke.
 - d. Obstacles are often constructed at the expense of concealment in the desert. The effort required to improve natural obstacles and construct artificial ones must not be underestimated.
 - e. Gaps between obstacles and safe lanes through them are essential to avoid restricting our own mobility. When the air situation is less favourable more gaps are required, consistent with the ability to defend them from air attack and close them quickly in an emergency, to avoid providing the enemy with targets of bunched vehicles. They must be covered by observation and fire.
 - f. In future, mine and other obstacle systems will be laid rapidly or remotely delivered and controlled, ie, switched on and off. Modern systems will offer much greater flexibility, permitting obstacles to be put down in the midst of, in the path of or around an enemy force. For example, four standard 800 metre minefields, separated by 600 metre gaps can be laid behind a guard force during a meeting engagement by an engineer regiment in about 3 hours. When the guard force withdraws, a vehicle launched scatterable mine system (VLSMS) can be used to close the gaps. In a counter-penetration role 800 metre live minefields can be laid at right angles to the front with phoney minefields between them to protect a blocking position. Again, VLSMS can be used to lay mines in the phoney minefields and in the gaps.
 - g. The destruction of wells and water supplies may hold up guerrillas and a poorly equipped or supplied enemy. Denial of local water resources, static purification plants and storage facilities may well impose delay on better equipped regular enemy forces during a long withdrawal.
21. ***Aiding Movement.*** Engineers provide the following mobility and associated support requirements in the desert:
- a. Terrain analysis. Important for making appreciations for manoeuvre in the attack or counter-attack and the siting of delaying and defensive positions.
 - b. Minefield and obstacle breaching or crossing. GPS is useful for the accurate plotting of minefield gaps.
 - c. The construction and maintenance of roads and routes. This requirement

entails a considerable effort, particularly as the communication zone is extended during a prolonged advance.

22. **Other Essential Engineer Support.** A considerable engineer effort will be needed to provide the following facilities:
- a. Survivability, in terms of field defences, digging in gun positions, fortifications and camouflage on a large scale.
 - b. Deception. Implementing the construction aspects of a force deception plan.
 - c. Water supply: purification, pipelines and storage facilities.
 - d. Fuel: pipelines and storage facilities.
 - e. The construction and maintenance of forward operating bases (FOBs) for STOL/VTOL aircraft, and of forward arming and refuelling points (FARPs) for attack helicopters.
 - f. The improvement of existing airfields for use by combat aircraft, transport and support helicopters.
 - g. The construction of training facilities, such as ranges and the reproduction of enemy defence systems to practise breaching operations.

Signals

23. **Maintenance of Communications.** The main practical problems concern the maintenance of communications over long distances, the frequency of movement and the difficulty of operating equipment as the vehicles bump, lurch, stop and start over stony and sandy ground. The damage caused by constant vibration, sand seepage and the expansion and contraction due to marked changes in temperature between day and night, winter and summer, degrade radio equipment far quicker than in temperate climates and less dusty environments. An increased scale of spares is required and the need to increase workshop establishments may have to be considered. Particular attention must be paid to routine maintenance and equipment checks because of the wear and tear problem.
- 24 **Vulnerabilities.** IT equipment will always be vulnerable to failure in a desert environment. The following measures will reduce the effects:
- a. Always place servers in air conditioned vehicles.
 - b. Allow 0.5 m clear space behind workstations.
 - c. Place computers on small plinth to allow air to circulate underneath.
 - d. Turn off computers when not in use.

- e. Use shared printers located in as dust free environment as is possible.
 - f. Do not use floppy drives, hold IMPEX PCs in as dust free as possible environments.
 - g. Cover keyboards in microwave cling film (which is breathable) to prevent dust ingress.
25. **The Limitations of Line.** ESM, ECM and EPM in the desert are much the same as in any other theatre but the lack of a basic telecommunications structure, except in some of the oil producing areas, will place a greater burden on radio. The distances covered in the ebb and flow of desert warfare, the effort required to bury hundreds of miles of cable and the vulnerability of line laid on the ground, or strung on poles, to vehicle damage, let alone enemy action, all exacerbate the problem. When line is laid in the forward area in static conditions it should be buried, when the ground allows, sufficiently deep both to avoid damage by and to vehicles, and to deny enemy patrols an easy method of locating headquarters. As excavations show up on air photographs and other imagery they should follow existing track plans. In rocky ground there may be no alternative to stringing line on poles. The line should be strung close enough to traffic routes for maintenance but just far enough away to avoid damage from high vehicles and radio antennae.
26. **EMCON.** Even with secure nets, point-to-point communications and burst transmission the enemy may be able to detect any sudden increase or decrease in the volume of traffic, alerting him to our intentions. The need to harmonize electronic deception with the commander's overall deception plan has already been mentioned. The emission control (EMCON) plan must reflect the latter meticulously. The aim may be to support a feint attack to persuade the enemy from committing his reserves against our main effort until it is too late or to disguise the arrival of fresh formations in the area where an attack is to be launched. The power output of transmitters can be reduced so that their signals cannot be detected by the enemy while previously recorded traffic, which it is certain that the enemy has not already heard, can be broadcast from the formation's old position.³
27. **Jamming.** Because formations and units manoeuvre over longer distances than in most other theatres their nets will be more susceptible to enemy ECM. Conversely, a concerted jamming programme designed to disrupt selected enemy command nets,

3. During 1 Armoured Division's training period on the Devil Dog Dragoon Range some 30 miles north of Al Jubail on the Saudi coast the Fleet Electronic Warfare Support Group recorded the exercise radio traffic. When the Division moved over 200 miles north-west to the KEYES concentration area near al Qaysumah the radio traffic was retransmitted on similar schedules to those originally used. To conceal the Division's presence there, especially during the final FTXs, the communications staff worked out the likely intercept ranges for all the Divisions' radios for any given power level. The power level was controlled so that the Iraqis could not pick up the Division's transmissions unless we wished them to do so. The start of the air war grounded the Iraqi airborne sensors, making the concealment of the Division's presence easier. The broadcast of the old radio traffic ceased just before the final exercise while the Division used VHF only at lower power, 1 watt. During the east-west move, medium power and HF were used so that if the Iraqis picked up the signals they would think the Division was rejoining the US Marine Expeditionary Force on the coast. When the Division moved west again to the forward assembly area RAY to join VII(US) Corps the Fleet Electronic Warfare Support Group moved up to KEYES to broadcast more old exercise traffic.

interfere with his fire support control nets and confuse his air defence radars, radios and communication systems at the start of an attack or on the launching of a counterstroke may paralyse the enemy's reactions for a short but vital period, particularly if we move at speed. By the same token our forces must have pre-planned EPM to deal with precisely the same threat when the enemy seeks to use the same methods against us. Security on radio nets must be drummed into every user.

28. ***Exploiting the Emission Range Factor.*** In general, in desert conditions:
- a. HF direction finding is more useful because it functions over a longer range.
 - b. Unless the enemy has a sophisticated airborne EW capability VHF communications are less susceptible to intercept and DF because of the comparatively short range of VHF systems vis-a-vis the wide areas over which forces manoeuvre in desert warfare.
29. ***Earthing.*** Earthing of communications installations in the desert can be difficult. The following measures should be implemented to improve this:
- a. Put salt in the bottom of earth spike holes to create a mild electrolyte.
 - b. Keep earth spikes wet, if the vehicle has an ACU put the water drain over the earth spike.
 - c. In static locations dig a trench, fill bottom with food waste and water, cover in hessian, refill trench and then drive earth spikes into it.
 - d. Instruct operators not to have one foot on ground and one foot on vehicle at any time.

CHAPTER 9

NUCLEAR, BIOLOGICAL AND CHEMICAL CONSIDERATIONS

SECTION 1 - THE ENVIRONMENTAL EFFECTS

The Threat

1. The Middle East continues to be a focus for the proliferation of NBC weapons. In recent conflicts in the Middle East chemical weapons have been used to some tactical advantage and have even achieved some operational and strategic results.¹ An enemy anxious for a quick decision or facing imminent defeat, who is prepared to accept retaliation in kind from a power which possesses such weapons or some other form of retribution, may hint at their use to induce caution or actually employ them. The threat or use of nuclear weapons may be less likely but cannot be ruled out, especially if vital interests are in jeopardy or total defeat seems possible. Because cities and civilian populations are not directly affected by NBC weapons used in desert areas there may be fewer inhibitions on their tactical use and perhaps a greater risk of their employment than in any other environment. On the other hand, those population centres which do exist are especially vulnerable because of their greater relative importance and a potential initiator may be apprehensive that his own cities and industrial infrastructure would be put at risk by first use.
2. The UK does not possess a biological or chemical capability to effect 'deterrence in kind'. However, well practised and advertised defensive measures may persuade an adversary that their employment would be unlikely to produce a quick and irreversible victory. Consequently, an enemy would be obliged to appreciate that any result falling short of a speedy decision may not justify the risk of incurring not merely international odium but, possibly, a damaging retaliatory escalation of the conflict in a manner which would be seriously injurious to the perpetrator.

NBC Weapons Effects in a Desert Environment

3. **Temperature.** In deserts, temperature changes can be as much as 30-40° C in the matter of a few hours. The guidance below is principally aimed at daytime operations.
 - a. *Nuclear.* The hotter the air the less dense it is and the faster nuclear blast waves travel. Although the overpressure is slightly less, the lack of cover in desert open terrain maximises the blast effect.

1. Without the use of chemical weapons the Iraqis might not have contained the Iranian attacks on Qurna in February and March 1984, the loss of which would have threatened the Baghdad-Basra road. Chemical weapons made a significant contribution to the Iraqi operations which recovered much of her lost territory towards the end of the war in the summer of 1988. Starting with the recapture of the Fao Peninsula at the end of April the Iraqis expelled the Iranians from their bridgehead over the Shatt al Arab in May and took Mehran, on the Iranian side of the frontier in the central sector, and the Majnoon Islands in the marshes to the East of Qurna in June. They also used chemical weapons extensively against their own Kurdish population in the north which had sided with Iran in a bid for independence.

- b. *Biological.* While direct sunlight degrades most biological agents, toxins and spore-forming germs are unaffected.
- c. *Chemical.* Desert conditions are not particularly well suited to the use of chemical agents originally formulated for employment in temperate climates. Highly non-persistent agent will dissipate quickly in the heat and unstable conditions, unthickened liquid agents will be absorbed by sandy or dusty surfaces, and thickened liquid agents may be covered by sand or dust blown by the wind. Conversely, proliferators will be conscious of these factors and are likely to adopt agents better suited to desert employment, whilst also recognising that human performance degradation resulting from the imposed use of IPE is greatest in extreme climates and will thus work to their advantage.
- d. Chemical agents become more volatile as the temperature rises. This will produce higher concentrations of vapour over shorter periods of time but these will disperse and evaporate quickly in the heat of the sun and the turbulence of the air in daytime. Persistent agents produce a greater hazard but for a shorter time and the contact hazard time will also be shorter. Blister agents in both liquid and vapour form are particularly effective against hot sweater skin.
- e. At night when the desert cools down and the hot air rises, cooler air is trapped between the surface and the war air above. This temperature inversion produces a stable layer of air in which chemical and biological agents are trapped so that these weapons become increasingly effective as the night passes on. Just before dawn these agents would reach their optimum level of lethality. A thickened liquid sprayed on to the desert just before dawn will start evaporating to cause a downwind vapour hazard as soon as the sun rises high enough to heat the surface. The hotter the season the quicker an effective concentration will form. As the day wears on blown sand, as well as evaporation, will gradually degrade the agent's effectiveness. An unthickened liquid may seep down into sandy ground where it will give off vapour for a time, although it will not be a contact hazard. It is not possible to predict with accuracy just how long a chemical hazard will last but Table 1 below gives a rough guide.

Ser	Agent				
		0°C (32°F)	Under 20°C (under 68°F)	20°C to 30°C (68°F to 86°F)	Over 30°C (Over 86°F)
(a)	(b)	(c)	(d)	(e)	(f)
1	Unthickened Nerve	1 day	1 to 2 hours	Up to 1 hour	Minutes
2	Thickened Nerve	1 day	Up to 12 hours	Up to 2 hours	Up to 1 hour
3	Blister	1 to 5 days	1 to 2 days	Up to 12 hours	Up to 6 hours

Table 1 - Duration of Chemical Hazard

4. **Wind.** At times of the year when wind and weather are very predictable, NBC weapons could be exploited to produce downwind hazards over huge distances. At the change of seasons when the atmospheric conditions are less predictable the use of such weapons would be less effective and possibly more dangerous for the initiator.
 - a. *Fallout.* Wind effects will cause radioactive hot spots to build up against escarpments and in defiles. The large amounts of sand and dust stirred up by ground or low airbursts will be carried for great distances by the wind, spreading the contamination.
 - b. *Biological.* The effectiveness of these agents is not reduced by the wind but they are carried further producing a hazard that is more widespread.
 - c. *Chemical.* Apart from the danger of a pre-dawn attack, previously referred to, chemical weapons eventually disperse once the desert heats up to produce convection and a strong breeze to carry them away and render them less effective.
5. **Terrain and Nuclear Effects.** In open desert the lack of terrain features will expose troops to direct radiation, blast and dazzling effects of nuclear weapons over great distances. The flash of a nuclear explosion will cause severe burns to exposed troops in tropical clothing and shirtsleeve order. At night the dazzle effect may reach out as far as 80 kilometres. In such circumstances particular care must be taken to warn aircrew and observers using night vision aids. The looser the sand the more radioactive dust will be stirred up, with the downwind contamination effect mentioned at para 52 a above. In the immediate vicinity of ground zero, sand containing a large quantity of silica will tend to fuse into a glasslike substance, although heavy-duty tyres should not be affected.

SECTION 2 - OPERATIONS IN DESERT CONDITIONS

6. Operations in the face of NBC hazards in desert environments will be characterised by:
 - a. Limited opportunities for concealment, resulting in enhanced risks of successful enemy targeting.
 - b. High daytime temperatures with resulting degradation of human efficiency.
 - c. Lack of water, compounding the effects of heat stress and reducing opportunities for decontamination.
 - d. Extended lines of communication across potentially huge distances and via a limited number of routes, rendering the supply chain vulnerable to interdiction with nuclear weapons or persistent chemical agents.
7. Vulnerability reduction measures such as concealment, dispersion and deception will build upon wider operational doctrine, enhanced by the hazard-specific guidance offered in AFM Vol 1 Part 5 *Operations in NBC Conditions*, whilst the means of

countering the risks of heat stress together with additional tactical and procedural responses to be threatened or actual use of NBC weapons in various phases of operations are set out below.

Personal Protection in Hot Climates

8. Wearing respirators and protective clothing is exhausting in a hot climate. NBC suits hinder the evaporation of sweat and heat loss to such an extent as to induce serious stress. Excessive sweating may reduce the effectiveness of an NBC suit. Inner gloves and socks become saturated, leading to maceration of the skin. They should be changed as often as possible and allowed to dry out. Hot weather, particularly if humid, encourages troops to loosen or remove clothing. However, for the NBC suit to provide effective protection, it must have underneath it at least one layer of lightweight clothing as well as a layer of underclothing that covers the armpits and crutch. Wearing these 3 layers of clothing in such conditions will make troops considerably less efficient and more subject to heat stress.
9. **Heat Stress.** Heat stress is a grave danger. Commanders must watch carefully for symptoms and consult their medical staffs. Where possible strenuous work should be carried out by night or in the cooler part of the day. The work/rest ratios for active tasks will have to be adjusted to avoid heat stress; when wearing IPE it may be necessary to reduce the ratio to as low as 10 minutes work with 30 minutes rest, as set out in the Guide at Annex A to this Chapter. Commanders should reduce the NBC dress state whenever possible but any decision will need to be made based on careful and informed judgements if troops are not to be exposed to undue risks (see paragraph 11 below). Atropine, when injected, interferes with the sweating mechanism, thus tending to worsen the effect of heat stress.
10. **Water Intake.** The amount of water a soldier wearing a respirator and protective clothing needs to drink to avoid dehydration and heat exhaustion is greatly in excess of the normal quota. A mandatory drinking routine will have to be stringently enforced to replace liquid lost by the body; it will not be sufficient to just quench the thirst. A guide to the individual water requirement for varying categories of NBC dress and temperatures is at Annex A. Although the S10 Respirator is fitted with a drinking device there remains the problem of supplying and carrying sufficient water in battle.
11. **Assessment of Risk.** Commanders must balance the risk of surprise attack, either directly on their own units or indirectly by being stationed downwind of a likely target, against the risk of heat exhaustion and the general degradation of all-round efficiency when considering the dress state to be adopted. Commanders must continually reassess the risk in the light of the development of operations and the enemy's perceived intentions. The temptation to keep troops in IPE as insurance must be resisted. Factors which should be considered include:
 - a. The task and the workload involved in relation to the temperature and humidity.
 - b. The fitness, freshness or fatigue of the troops.
 - c. The availability of water.

- d. The anticipated amount of warning of attack.
- e. The detection equipment and alarms available.
- f. The protection afforded by any cover.

Tactical Considerations

12. **Offensive Operations.** Concentration in advance of break-in and breakthrough operations against prepared defences will provide an adversary with ideal nuclear and chemical targets; biological attack will be less likely having regard to the delayed time-to-effect. Even though the assault troops might escape attack once intermingled with the enemy, the supporting artillery and reserves would remain vulnerable so that the assault echelon might be deprived of support and reinforcement. There will be a premium on using the space of the desert for enveloping and encirclement operations on as wide a front as the ground allows. Engaging the enemy's reserves from an unexpected direction and overrunning his logistic and headquarter areas will inhibit his use of chemical weapons. Similarly, advance and pursuit should be carried out on a wide front to avoid presenting attracting targets in defiles and amongst the congested traffic, which builds up behind bottlenecks.
13. In the heat of the day, the activity of troops wearing individual protective equipment (IPE) will be severely limited. Operations will not be impossible but their scope will be restricted. If there is a chemical threat, the optimum times to carry out an attack will be in the cool of the night or in the early morning before the sun gets too hot. This will leave the enemy, who may wish to use these weapons to support a counter-attack, with the options of wearing IPE in the heat of the day or postponing the operation until nightfall, so giving friendly forces time to consolidate on the new position. It must be assumed, however, that an enemy - particularly if desperate and facing defeat - may use NBC weapons at any time of the day.
14. **Defensive Operations.** Every effort must be made to deny NBC capable adversary detailed knowledge of friendly dispositions. Strong covering troops and a false front to prevent ground reconnaissance of the main defensive position, an air defence umbrella and at least a favourable air situation over the area of operations will all help to make enemy target acquisition more difficult and uncertain. All troops, whether in defensive positions or held in reserve, must be well dug in and protected, especially in the face of a nuclear threat. It may pay to deploy the minimum number of troops forward to hold key terrain against the risk of a conventional attack, consistent with avoiding the risk of defeat in detail. The remainder should be kept in reserve, well dispersed, to avoid presenting a worthwhile target. These reserves should be capable of concentrating for counter-attacks to regain key terrain should the threat recede. The greatest threat of chemical attack is at night or in the early morning when

it is cool enough for the attacking enemy to wear IPE and when chemical weapons would be at their most effective in terms of agent behaviour. Similarly, biological attacks are most likely in the night hours; the aim here will be attrition rather than preparation for an early attack.

15. **The Withdrawal.** A withdrawal in the face of nuclear or chemical threats should be carried out suddenly, secretly, with great rapidity and over as wide a front as possible to prevent the enemy from locating, targeting and striking troops while they are at their most vulnerable on the move. If time permits the rearmost troops and echelons should be thinned out discreetly beforehand. Careful route planning and traffic control will be necessary to avoid offering profitable targets, especially at defiles through broken country or in bad going.
16. **Rear Operations.** As almost every commodity to support life and combat in the desert has to be imported, stored and moved huge distances in the open, logistic systems are more susceptible to interdiction than in European and most other terrains. The static nature and size of logistic facilities makes them peculiarly vulnerable to NBC attack, limited only by the range of the enemy's delivery systems and the means of targeting them. Ports, airfields, main supply depots and workshops provide particularly attractive targets. Where there is a risk that the use of especially nuclear weapons and persistent chemical agents is anticipated such installations must be dispersed and duplicated. Minor ports must be developed for use, airfields identified and stocks of every kind of commodity dispersed to present the enemy with as difficult a problem as possible in disrupting our maintenance and repair system.
17. **Medical.** Plans must be made to cope with mass casualties, a proportion of which may be contaminated. At the time of an NBC attack it will be necessary to establish an order of priority for dealing with affected formations. Because of the openness of the terrain a much larger number of casualties can be expected from enemy nuclear and strikes than in a European theatre. If there is an NBC threat, additional medical units should be sent out to the theatre so that more field hospitals and medical units can be cleared and held in reserve to meet a sudden demand on the existing medical resources. Medical units should be provided with collective protection to allow continued patient treatment and care in the face of enduring hazards.

Equipment Husbandry

18. The principal considerations effecting the conduct of NBC defence in desert environments arise from the effects of heat on the individual soldier, as described at paras 8-11 above. Additional factors include the open nature of the terrain with its consequent enhancement of certain nuclear weapon effects and the impacts of high temperatures on chemical agent behaviour; these too have already been discussed. There remain certain impacts on equipment that derive from the likely lack of water supplies and the frequently dusty conditions; these are:
 - a. **Decontamination.** Water supplies will always be at premium in the desert and this problem will be compounded if water points become contaminated. Unless vehicles and positions can be stocked with extra water it will be difficult to clean contaminated equipment. In coastal areas, seawater may be used for decon-

tamination purposes, although this may have long-term corrosive effects on pumps and certain sensitive equipments. Inland salt-lakes should only be used in extremis as the dissolved material will reduce the uptake of decontaminants. In the case of chemical contamination Fullers Earth should be used, if available. Brushing with solvents such as diesel, petrol, kerosene, light oils and fats can also remove chemical agents but the waste will remain active to give off a toxic vapour as it evaporates. Talcum powder is another useful substitute for Fullers Earth. As a last resort, dust/sand from the desert surface may be used.

- b. *Protective Equipment.* Respirator canisters and collective protection (COLPRO) filters are liable to blockage by sand and dust and must be checked regularly. Air that is pumped into collective protection needs to be cooled to avoid excessive discomfort, but it must not be cooled until after it has been filtered otherwise filter efficiency will be reduced. Special air conditioning units are available for this purpose.
- c. *Detectors.* NAIAD is susceptible to blockage by sand and dust and must be checked regularly. A modified air inlet collar for use in the desert should be fitted prior to operations. CAM should be run in high daytime temperatures for 12 hours before first use. Batteries should be changed in the cool of the night or in the early morning.

WORK AND REST TIMES AND WATER UPTAKE REQUIREMENTS

1. The commander must lay down the level of NBC IPE to be worn for any activity to revert when in the presence or at risk of NBC hazards. In so doing, he will have to balance a number of related factors including the urgency of the task to be performed, the time available, the number of men available, the character and concentration of any known hazards, the threat level and the ambient temperature.
2. As general guidance, when the operational situation permits and when the temperature does not make heat stress a limiting factor, it is advised that a routine be followed of 50 minutes work then 10 minutes rest.
3. In daytime desert conditions, where the temperature makes heat stress a limiting factor, the accompanying tables should be considered as a guide; the times shown are based on average responses of fit, young men. Such figures are not absolute, nor are they reliable predictions of the physiological responses of all individuals in similar conditions. The commander will have to temper these guidelines with experience and knowledge of the unit's standard of physical fitness, training and acclimatisation. Furthermore, the following tables are based on the Mark 3 NBC Suit, S6 Respirator and the Combat Suit which pre-dated Combat Soldier 95 clothing. However, the heat stress arising from this ensemble will be greater than from the current Mark 4 NBC Suit, S10 Respirator and Combat Soldier 95 clothing. Work is currently in progress to determine appropriate guidance for the latter combination of IPE and clothing.
4. Personnel must be alert for signs of heat stress, such as rapid breathing and pulse rate, nausea, dizziness, cramp, or a hot, sweaty, flushed face turning cold. In hot weather, these symptoms may not always be apparent to the sufferer.
5. The following tables assume:
 - a. An adequate supply of water is available for drinking. Water for cooking, washing etc is additional.
 - b. NBC dress states are as detailed in STANAG 2984 and repeated in AFM Vol 1 Part 5.
 - c. Workloads have been taken as:
 - (1) Light: Sedentary work, light vehicle driving, vehicle maintenance and routine guard duty.
 - (2) Moderate: Marching in battle order, heavy repair work, moving light stores, digging.

- (3) Heavy: Forced marching, dismounted assault, fire fighting and rescue, moving heavy stores, rapid and continuous supply, digging in under fire.

Ser	Temperature	NBC Dress State	Work Load	Work Period (mins)	Rest Period (mins)
(a)	(b)	(c)	(d)	(e)	(f)
1.	Below 20°C (heat stress unlikely to be a limiting factor)				
2.	Warm (20°C-24°C)	2, 3	Light	50	10
3.			Moderate	50	10
4.			Heavy	20-30	10-15
5.		4R	Light	40-50	40-50
6.			Moderate	30-45	30-45
7.			Heavy	15-20	15-20
8.					
9.	Hot (25°-30°C)	2, 3	Light	40-50	40-50
10.			Moderate	30-45	30-45
11.			Heavy	15-20	15-20
12.		4R	Light	25-40	50-80
13.			Moderate	20-30	40-60
14.	Very Hot (30°C +)	2, 3	Heavy	10-15	20-30
15.			Light	30-40	60-80
16.			Moderate	20-30	40-60
17.		4R	Heavy	10-15	20-30
18.			Light	15-25	45-75
19.			Moderate	15-20	45-60
			Heavy	5-10	15-30

Table 1 - Guidance on Work/Rest Periods in NBC IPE

Notes:

- In cold conditions, insulation and work rates will have to be varied to avoid saturation of inner clothing by sweat.
- When wearing full IPE less respirator (State 4) the work/rest periods should be closer to those for State 2 and State 3 than those for State 4R.
- The tables are based on the Mark 3 NBC Suit, S6 Respirator and the Combat Suit which predated Combat Soldier 95 clothing. The heat stress arising from this ensemble will be greater than from the current S10 Respirator, Mk 4 NBC Suit and Combat Soldier 95 clothing.
- When the operational urgency is such that no rest can be permitted, the maximum work periods for minimum heat casualties are given in minutes in column (d) and (e) below. Column (d) is for when wearing combat suit and (e) when wearing shirt and light trousers (plus suitable underwear in each case) under the IPE.

Ser	Temperature	NBC Dress	Work Load	Max Work Period Wearing IPE + Combat Suit & Underwear (mins)	Max Work Period Wearing IPE + Light Shirt, Trousers & Underwear (mins)
(a)	(b)	(c)	(d)	(e)	(f)
1.	Warm (20°-24°C)	2,3	Light	-	-
2.			Moderate	-	-
3.			Heavy	-	-
4.		4R	Light	-	-
5.			Moderate	80	-
6.			Heavy	60	80
7.	Hot (25°-30°C)	2,3	Light	-	-
8.			Moderate	90	-
9.			Heavy	70	90
10.		4R	Light	85	-
11.			Moderate	75	100
12.			Heavy	45	55
13.	Very Hot (30°C +)	2,3	Light	70	110
14.			Moderate	60	80
15.			Heavy	40	60
16.		4R	Light	45	70
17.			Moderate	35	50
18.			Heavy	25	40

Table 2 - Maximum Work Periods in NBC IPE

7. Guidance on water uptake requirements is provided in Table 3 below.

Ser	Temp (°C)	NBC Dress State	Water Required Under Work Conditions (litres/day)		
			Light	Moderate	Heavy
(a)	(b)	(c)	(d)	(e)	(f)
1.	Mild (10-19°C)	2	5	5	5
2.		4R	5	7	7
3.	Warm (20°-24°C)	2	5	7	7
4.		4R	7	7	10
5.	Hot (25°-30°C)	2	7	10	15
6.		4R	10	15	15
7.	Very Hot (30°C +)	2	15	15	15
8.		4R	15	15	15

Table 3 - Water Uptake Requirements in NBC IPE

CHAPTER 10

COMBAT SERVICE SUPPORT (CSS)

SECTION 1 - BASIC CSS CONSIDERATIONS

General

1. The principles of providing effective CSS are unaltered by desert terrain. The terrain does, however, place an added burden on distribution, storage and maintenance. Any military formation is likely to be well spread out and this, combined with poor ground communications adds to the problem of keeping combat units properly and regularly supplied and of dealing with casualties to both men and equipment.

Principles

2. The principles of CSS are detailed in AFM Vol 1 Pt 6 *Combat Service Support*. These remain the same for desert operations, however, priorities will change and factors that may be ignored in temperate regions could become critical elsewhere.

Size and Composition

3. The friction of the desert, vehicle availability, fatigue and driving conditions, as experienced in recent desert operations, suggest a level of CSS support is required which is significantly above that normally established with the deployed formation, in order to successfully sustain operations. The composition and size of any military force that can be sustained in desert conditions depends on:
 - a. The number and capacity of the roads and routes and the means of improving them.
 - b. The amount of ground and cover available for deployment off route.
 - c. Availability of specialist transport, equipment and supplies.
 - d. Climate.
4. Other factors that also influence the logistic support of operations in desert terrain are as follows:
 - a. Air situation.
 - b. Availability of air transport support.
 - c. Availability of CSS units to support the force, including those required for air resupply.

SECTION 2 - CSS PLANNING

General

5. Success in desert operations is unlikely to be possible without a coordinated and flexible CSS plan. Such a plan will stem from the SUSTAT produced by PJHQ and is

likely to be based on the principles of CSS after a detailed appreciation of the facilities available. The following paragraphs identify some of the topics which merit careful consideration during the formulation of a CSS plan.

Reconnaissance

6. Detailed reconnaissance is required to cover:
 - a. The road and going conditions to decide the type and maximum number of vehicles that can be employed in the area. The construction of new roads or improvements to existing ones may need to be considered in order to support protracted operations in isolated areas.
 - b. Possible deployment areas and suitable sites for administrative areas and bases.
 - c. Suitable sites for DZs, LSs and short range tactical airstrips.
 - d. Availability of water sources.
 - e. Availability of local resources.
 - f. Special equipment required.
 - g. Availability of hardstanding for equipment support repair assets.

Command and Control

7. **Planning.** A flexible and comprehensive CSS plan for supporting operations in the desert will depend on a combination of forward planning (reconnaissance stockpiling and replication) and adjustment by regular checks on the vital aspects of a CSS plan, (good communications, reserves, alternative supply arrangements and regular monitoring of stocks).
8. **Echelon System.** Echelon systems may help in the development of a sound CSS plan although they do not vary significantly from that pertaining to other operations.

Combat Service Support

9. **Supply.** The frequency of distribution of supplies will be affected by the terrain and disruption to lines of communication. Cross servicing of essential items between units will seldom be possible. In such circumstances essential supplies should be carried within forward formations and units. It may be appropriate to increase the initial stocks and holdings of certain equipments or supplies - partly to take account of the increased affiliations of units and specialists.
10. **Stockpiling.** In mobile operations excessive quantities of supplies should not be carried forward as this may limit mobility and require troops to guard grounded stocks. In static or mobile operations centred on defended bases, stockpiles may be established to provide a buffer against failures in the resupply system. Such stockpiling generally requires an increased level of stock holding in theatre. However if supplies are limited, centralized storage and control is usually more efficient, particularly if an efficient air resupply system is in operation.

11. **Limited Resources.** Good communications, centralized store holding and air resupply provide the most efficient use of limited supply resources in desert regions.

Logistic Support

12. **Scaling.** It is essential that there is close cooperation between G1/G4 staffs and logistic support representatives at the planning stage of operations to ensure that the stores scalings reflect the specific equipment requirements for operations in desert conditions.
13. **Unit Replenishment.** Unit replenishment may be done on a push or pull basis depending on the environment and tempo of operations. Pull replenishment is based on complete unit demands and coordinated through the Bde DCOS. Push replenishment has in the past been based on a daily maintenance pack (DMP) where units are provided with a pre-determined selection of commodities. Units may demand increases or reductions daily in individual items. This system simplifies unit action, allows forward planning of transport, particularly by air, and establishes a regular routine. The DMP scale can be revised in the light of experience gained during an operation. This procedure ensures that combat supplies are delivered regularly to forward units even if radio communications are poor.
14. **Combat Supplies.** Terrain characteristics usually reduce the number and type of equipments deployed within the force. This reduction in equipment dependency will be reflected in a reduced supplies requirement. Materiel support may be limited to spares for communication equipments and light weapons. Similarly, combat supply support may be restricted to rations and small arms ammunition. Resupply by vehicle will increase fuel consumption and the need for repair units and larger stocks of vehicle spare parts (tyres, gear boxes and engines).
15. **Special POL.** There will probably be a requirement for special POL products to support equipment operating in extremes of climate.
16. **Ammunition.** The difficulty of observing fall of shot and increased use of smoke is likely to lead to high consumption rates. The limited range of light artillery equipment may require frequent change of gun position so limiting the ability to stockpile ammunition. Furthermore ammunition resupply may be limited by the available transport. It is thus essential that the resupply system for all natures of ammunition required for operations in desert areas is planned as early as possible.
17. **Water.** In all theatres adequate water supply is essential to maintain fighting efficiency, hygiene and morale. In the desert, supplying water will pose difficult problems. Although efficiency can be maintained for short periods on emergency rates, normal requirements for drinking have to be met as soon as possible. It is important that RAMC advice is sought before minimum consumption rates are set within a theatre of operations.
18. **Selection and Testing of Water Sources.** In general, reconnaissance, selection and development of water sources and subsequent treatment are an engineer responsibility. The RAMC is responsible for testing for poisons and toxic substances.

The collection of water is a unit or RE responsibility but RLC assistance may be required for bulk movement. As suitable water sources in arid mountainous areas are often scarce or inadequate, operational plans should always cover water supply and distribution. It may be necessary to hold positions specifically to retain access to a local water source.

19. **Water Discipline.** The human body cannot be trained to function without water or to operate on a reduced intake. If there is a shortage of water, the following rules of water discipline should be enforced:
 - a. There have to be orders for drinking to prevent troops husbanding supplies and precipitating a state of dehydration leading to a deterioration in performance. This could be particularly important in a chemical environment when troops are forced to wear full IPE.
 - b. All water should be sterilized before being used for drinking or for washing and cooking food. Water for personal washing does not need to be purified unless grossly polluted. All water sources should be reported; their positions logged at unit or formation HQ and a medical officer should test them for diseases and poisons. Individual sterilising kits are issued for use when water is not available from a military water point.
 - c. Issue of water has to be strictly controlled. Sources likely to be required for drinking must not be polluted by washing or by animals.
 - d. If drinking has to be temporarily restricted when supplies are inadequate, fluid balances must be fully restored by the end of each 24 hour period.

Medical Support

20. Bulk resupply of medical resources in theatre requires particular coordinated planning and control by RAMC and RLC staff. Specialist medical equipment can be supplied into the theatre in the normal way but allocated from there on under RAMC control. A commander should note that the potential extremes of climate and the physical conditions involved in operating in a desert environment will raise the emphasis to be placed on medical expertise and resources. It would be prudent to ensure that medical staff are able to operate under the best possible conditions and that these are clearly underpinned by an effective medical support process.

Equipment Support

21. **General.** Harsh desert terrain conditions are likely to increase the repair load, particularly on tracked and wheeled equipment. At the same time inferior road communications will make it difficult to carry out routine recovery from forward areas to the local base. Emphasis will therefore be on having repair teams and repair facilities forward with urgently needed spares being flown in whenever possible and on improvisation by individual craftsmen. Increased flying rates increase the servicing requirement for light aircraft and helicopters.

22. **Camouflage Equipment.** Special camouflage clothing and equipment including nets are likely to be required in quantity. Stocks of camouflage paint should be held for the initial deployment and subsequent maintenance and replacement of vehicles, guns and equipments.

Transport Considerations

23. **Air Transport Support.** Maximum use should be made of all available air transport to enhance mobility. Where possible, helicopters should be used to deliver supplies direct to units and gun positions. Air support may be limited by weather, availability of LZs, DZs and the enemy air and ground threat. These limitations may in certain circumstances preclude reliance on air transport alone and alternative plans to use surface transport should be made. For fixed wing operations it is preferable to provide airland facilities due to the specialist equipment required for any intended air-drop. Engineer equipment may however, have to be dropped in advance to enable a suitable airstrip to be prepared or constructed. However in terrain at high altitude heavy drop direct to units may be required. Recovering heavy drop and underslung load equipments will need careful planning.
24. **Mechanical Transport.** Normal road transport should be used as far forward as possible although unit transport should be restricted to moving essentials. Units off the main axis should operate on light scales using vehicles capable of carrying up to one tonne. Unit transport not required should be centralized in base areas.
25. **Rail.** If railways exist in the general area, they should be fully utilised as they are particularly suitable for L of C tasks. The RLC retain a small number of railway trained officers who would advise on local railway resources.
26. **Loading Drills.** When loading materiel in any form of transport for delivery to an area of operations, items of low priority should be loaded first and those high priority items required first at the destination should be loaded last. Experience has shown that this principle is important in desert operations.

Traffic Control

27. The methods of traffic control assume increase importance when routes are poorly marked in deserts. In particular:
 - a. There is a requirement for early location and marking of bottlenecks, deployment areas for various types of transport. Alternative routes must be identified and allocated as soon as possible.
 - b. Good communications are essential, especially between start and finish points, on congested portions of the route and at any passing points.
 - c. A high standard of driving and discipline as required of all vehicle drivers.
 - d. There is a need for an efficient organization to clear obstacles caused by enemy action, the elements or broken-down vehicles.

- e. Particularly good signing is required for both day and night moves.
- f. Whenever possible at least two routes should be selected, one for vehicle traffic and the other for troops on foot. If possible, additional separate routes for wheeled and tracked vehicles should also be allocated.

Administrative (G1) Support

- 28. **Provost.** Roads and tracks should be properly marked, and cross-country routes, and hazardous points should be well signposted and marked with reflectors. All traffic control posts should be manned to provide for 24 hours assistance, advice and information.
- 29. **Prisoners of War.** Prisoners are a serious embarrassment in forward areas, even when they are adequately clothed, and they often will not be. Their rapid evacuation to avoid their becoming medical casualties, to prevent traffic congestion and to allow for their timely interrogation is important. When the enemy suffers reverses, either tactical or logistic, the number of prisoners may well be large, particularly if rations are running short and morale is low; arrangements must be adequate to cope with such a situation if forward troops are not to be seriously hampered.

DESERT OPERATIONS

PART B SKILLS, DRILLS AND MINOR TACTICS

CHAPTER 1

SURVIVING IN THE DESERT

SECTION 1 - ACCLIMATIZATION

Acclimatization

1. **Body Adjustment.** The body needs to adjust gradually to the harsh conditions of the desert. This Section outlines the ways in which the environment affects the soldier adversely. How to ensure that the man does not suffer and that he and his unit can operate effectively in a desert climate is a matter of training initially and constant supervision subsequently. There are five aspects to the problem:
 - a. Skin.
 - b. Cardio-vascular system.
 - c. Fluid-salt balance.
 - d. Glare.
 - e. Time to acclimatize.
2. **Skin.** Constant exposure to the sun ages the skin and those who over-expose themselves to sunlight for long periods suffer a much higher incidence of skin cancer. Severe burns can be inflicted at altitude where a thinner atmosphere provides less protection from ultraviolet radiation. A similar penalty can follow the exposure of unprotected skin at sea level under an overcast sky when the ultra-violet rays are scattered rather than absorbed by thin cloud. A suntan to protect the skin takes two to three weeks to acquire. Sun creams, such as Sunscreen, can be useful in the early stages of achieving a tan. Chapsticks, or petroleum jelly for those allergic to them, help to prevent cracked lips.
3. **Cardio-Vascular System.** The system needs time to adjust to hot weather for two reasons. It has to produce more blood to increase the amount required near the skin without robbing the main internal organs and it has to keep the pulse rate down.
4. **Fluid-Salt Balance.** With an increased water intake the body needs to adjust its ability to retain sufficient salt. Until a man is acclimatized he loses about 4 grammes of salt per litre of sweat. Thereafter he loses only 2 grammes per litre. Extra salt should only be taken on a medical officer's advice because too much can be as harmful as too little. In certain circumstances a medical officer may prescribe extra salt in water for the first three to four weeks in a hot desert in order to adjust the balance. Thereafter, the amount of salt in the daily composition is sufficient until more than 6 litres of water a day are drunk, when the medical officer must be consulted.
5. **Glare.** Radiant light comes from all directions. Not only does glare damage the eyes but it is very tiring. Dark glasses or goggles are necessary but should be shielded from direct sunlight to avoid give-away reflection. If neither glasses nor goggles are

available and the light is very strong some soot from a camp fire or a brew can smeared on the cheeks under the eyes will absorb some of the glare.

6. **Acclimatization.** The time it takes to become acclimatized depends on the season and location. For example, during the hot season in the North African Western Desert and Sinai it usually takes about two weeks, in the Arabian Peninsula about a month, provided that troops work in the heat and sweat. A very few men cannot acclimatize properly and they have to be sent home. Fit, thin men do well in the heat. Fat men cannot lose heat so easily and hard work in high temperatures can be dangerous for them. Some desert and gebel climates are so hot in the summer that operations requiring considerable exertion should be carried out at night.
7. **Artificial (Accelerated) Acclimatization.** Even during the hottest months, provided troops are fit, work in the heat and sweat profusely for two hours a day, 80% acclimatization can be achieved within four days and 100% in a fortnight. As a corollary, soldiers living in air-conditioned barracks or ships can maintain a good degree of acclimatization provided that they do hard physical work in the ambient temperature but they will lack stamina. The problem is that units may not have two weeks to acclimatize on arrival in an overseas theatre in the event of an operational emergency. In very hot weather a commander will attempt to fight by night, avoiding unnecessarily strenuous operations in the heat of the day. Even so, he may have to choose between accepting a high proportion of heat casualties and the loss of important ground or an essential entry point. If he is lucky, there may be a 'stand-off' period before the start of hostilities. In all but the direst of emergencies it will be necessary to pace work to start with. If troops arrive in extreme heat it may be necessary to work and train at night and rest by day.

Heat Illnesses

8. **General.** In hot conditions and on the move crewmen in the back of AFVs without air conditioning change physical state quickly and without noticeable symptoms. While this remains the case a procedural method of preventing this is to stop for 5 mins every 20 mins during long marches. The crew should then dismount, drink water and walk around in hastily erected shade. The cause is a drop in blood pressure and a lack of blood flow to the brain as the blood vessels near the surface of the body distend. The remedy is acclimatization which conditions the body to produce more blood to balance the system.
9. **Heat Exhaustion.** The causes are water or salt depletion and the symptoms are similar:
 - a. **Water Depletion.** This is brought on after a period of heavy sweating without fluid replacement. It is most common amongst the unacclimatized who have not learned to drink little and often or who ignore the dictates of thirst. The thirst sensation will diminish when the body is lacking salt. In addition, thirst is satiated when only about 75% of the water requirement is made good. So, drink water past the point of thirst quenching. The signs and symptoms of water depletion may be any of the following:
 - (1) Exhaustion, tiredness and anxiety.
 - (2) Dizziness and headache.

- (3) Lack of appetite.
 - (4) Vomiting and stomach cramps.
 - (5) Fast breathing or gasping for air.
 - (6) Rapid, weak pulse.
 - (7) Normal to raised body temperature.
 - (8) Scanty and highly coloured urine. If palid urine is passed once a day it is an indication of satisfactory hydration.
 - (9) Damp, clammy skin.
 - (10) Little or no sweating.
 - (11) Decreased conscious level leading to fainting and collapse.
 - (12) Shivering, with goose pimples on a hot skin.
- b. *Salt Depletion.* This may contribute to any form of heat exhaustion. Even without dehydration it may lead to severe cramp (stoker's cramp) in some circumstances.
- c. *Treatment.* For both water and heat exhaustion the treatment is:
- (1) Stop exercise and walking.
 - (2) Move into the shade.
 - (3) Drink water slowly, in frequent sips. An added electrolyte mixture may be added with medical advice.
 - (4) Lie patient down with feet elevated on any convenient object. Strip clothing to underwear.
 - (5) Fan the patient to create air movement over the skin.
 - (6) Sponge or spray the whole body with cool water.
- d. *Response.* Usually, the condition will respond to treatment fairly quickly. With continued fluid intake it should not recur. Should measures not be taken at the first signs of heat exhaustion the casualty's condition will deteriorate and could become fatal. If the patient does not improve rapidly he should be evacuated.
- e. *Awareness.* Directly symptoms appear in one member of a troop or platoon the commander must watch for further cases because the remainder may be close to the limits of tolerance.

10. **Heat-Stroke**

- a. *Symptoms.* The body's heat regulating mechanism fails and the victim's temperature rises steadily. Heat-stroke may or may not be produced by heat exhaustion. The onset is sudden, deterioration is quick and the consequences are severe because once the body temperature, normally 37°C (98.6°F), rises above 41.2°C (106°F) the cell proteins start to cook and death often occurs beyond 43.3°C (110°F). The symptoms are:

- (1) The skin reddens and becomes hot and dry to the touch.
- (2) Severe headache.
- (3) Staggering gait.
- (4) Confusion.
- (5) Irritability and aggressiveness.
- (6) Delirium.
- (7) Convulsions.
- (8) Coma.
- (9) The change from a full bounding pulse to a rapid weak pulse is a grave danger signal.

- b. *Treatment.* The aim is to cool the patient down as quickly as possible and certainly within an hour of collapse:

- (1) Lie the casualty in the shade immediately.
- (2) Strip off all his clothing.
- (3) Fan him continuously.
- (4) Drench him with water or wrap him in a wet towel.
- (5) Give him small sips of water if he is still conscious.
- (6) Send for medical help (to start an intravenous drip of saline solution).
- (7) Be prepared to give mouth-to-mouth resuscitation (exhaled air resuscitation, EAR) and external cardiac compression (ECC) at the rate of 15 compressions and two breaths for a first aider on his own and at a rate of five to one if two first aiders are present.

11. **Buddy Drills.** The buddy system and the watchfulness of commanders are the surest ways to detect heat illness early:

- a. Work in buddy pairs:
 - (1) Look for signs of heat illness in each other.
 - (2) If one starts to lag behind, the other must stop to help him, warning his commander.
- b. If one shows symptoms of heat illness, make him rest, cool him down and see that he drinks small sips of water often.
- c. Stop and drink every hour. Commanders must ensure that there are hourly breaks for rest and water.
- d. Drink plenty of water often and keep away from alcohol.

Other Medical Problems

12. ***Prickly Heat.*** The mechanism is not precisely known but inefficient sweat glands become blocked. Most people suffer from it in hot and humid climates to some extent but it is seldom more than an irritating nuisance. However, if a large proportion of the body is affected the ability to sweat will be severely limited and such cases may be serious enough for evacuation. To control prickly heat wear loose clothing, keep equipment off the back and shoulders whenever possible and wash the body regularly.
13. ***Snakes, Scorpions and Desert Rats.*** Snake bites are seldom fatal but serum given without knowledge can be. Scorpion stings are very painful but rarely lethal. The immediate first aid is to reassure the victim, immobilise the stricken limb as for a fracture, having washed away any excess venom, and get the victim to a medical officer as quickly as possible. Killing the snake or scorpion for identification is no longer necessary because modern serums can deal with a wide range of venoms but might be advisable to prevent further casualties, provided that it can be done without endangering the executioner. As a general precaution, boots and clothes should be shaken out before putting them on, latrine seats should be inspected before sitting on them and the ground examined for reptiles and insects hiding in crevices before lying down. Small scorpions are particularly hard to see. Bedding should be shaken out when getting up and before getting into it if it has been left lying on the ground. Soldiers should be warned of the dangers of keeping large scorpions and ferocious beetles to while away idle hours with mini-tournaments. The medical orderly who accompanies any detached party or long distance patrol should be in possession of the appropriate serums. While inoffensive, desert rats are a nuisance, eating holes in clothing and equipment.
14. ***Malaria.*** On the desert margins there may be a high risk of malaria. Protective measures taken against it will be effective against other insect-borne diseases.

Water

15. ***Daily Requirement.*** The amount of water, or tea, soup and non-alcoholic drinks, required in a 24 hour period for drinking varies with the temperature. The table below

is based on the individual requirement for a party of about platoon strength. For small parties 10% should be added to allow for differences in individual requirements. The temperatures look low because they represent the mean dry bulb temperatures between 0600 hours and midnight. The amount required at rest, sitting in a trench, for example, quickly exceeds a gallon, or 4½ litres, a day. As soon as a man starts to dig, march or fight, the effect is like standing on a radiator and the water requirement goes up sharply¹. Extra water is required for cooking and washing. These are worst case figures to be used as the basis for CSS planning so that men will never go short and suffer heat disorders. Should less be required for drinking, more will be available to make life in the desert more tolerable.

Mean Temperature Dry Bulb		Litres of Water		Percentage increase of (d) over (c)
(a)	(b)	At Rest (c)	Working (d)	
75°F	23°C	3 ½	5	43%
85°F	29°C	5	8 ½	70%
95°F	35°C	7 ½	12	60%
105°F	40°C	9 ¾	15	54%

Closed down in an AFV, crew members may need up to 20 litres a day. When respirators and protective clothing have to be worn to meet a chemical warfare threat the water intake must be increased considerably.

16. Water discipline is concerned with the careful use of the water available. A man can only be trained not to waste water. He cannot be made to drink less than is needed to keep his sweating mechanism working efficiently. Any attempt to condition men to water deprivation inevitably leads to heat casualties. The amount of water required to replace that lost through sweating varies with the severity of the climate and the degree of physical activity. As a rough and ready guide, a man loses about a litre an hour either working or sitting in an unairconditioned vehicle. Without replacement the loss of only 0.8 litres produces a measurable deterioration in mental performance and of 2 litres a significant lack of ability to do any hard physical work. A loss of 3 litres when working hard results in unconsciousness. Soldiers should be encouraged to drink even when they are not thirsty, especially before heavy work. By the time a man feels thirsty it may be too late to prevent trouble. Passing little urine is a sign of dehydration. Dark urine may be another indication but not a very reliable one.

17. Bottled water is so bland that it discourages men from drinking sufficient water. The optimum drinks for marching, working and fighting are fruit juice and powdered lemonade (jungle juice) because they satisfy taste as well as thirst and contain a useful amount of sugar. Sweetened tea is an excellent drink and, fortunately, popular in the Army. But the soldier will normally have to make do on water, a surprisingly satisfying and refreshing drink in the heat of the midday desert. However, bulk drinking water has a life span of only three days. Alcohol has a dehydrating effect. It lessens the body's resistance to the effects of heat and should only be drunk in the cool of the evening.

1. The requirement for 24th Independent Infantry Brigade preparing defensive positions in the summer of 1961 in Kuwait in a temperature of 112°F (44°C) was nearly 23 litres (5 gallons) a day per man.

18. Each man should carry two water bottles during the hot season in the desert. Every vehicle should carry reserve water in cans. Hot water is unappetizing and discourages soldiers from drinking enough fluid. Thermos style 'cool jugs' are the ideal containers. If they are unavailable, chaguls² may be issued. The latter should be fastened to the outside of vehicles. If carried on the man the chagul should not be allowed to touch clothes or skin to avoid chafing and to prevent leakage.
19. Water which comes from wells or other natural sources must be purified. Long range patrols and small independent bodies of troops should carry water purification equipment. Every effort must be made to conserve water. For example, cooking utensils can be cleaned with sand and water used for washing can be poured into vehicle radiators to save water for drinking.

Hygiene and First Aid

20. Personal hygiene is even more important in the desert than in Europe. Washing, shaving and brushing teeth regularly are particularly important. Every opportunity should be taken to wash down when showers and baths are not possible. Rest camps must have proper bathing, laundry and disinfecting facilities so that soldiers resting out of the line can get themselves and their clothes really clean. Whenever possible, hands should be washed before feeding.
21. Simple cuts and abrasions become inflamed and fester if they are not cleaned and dressed quickly; if ignored they can develop into persistent desert sores which take a long time to heal. Thorns from acacia trees and bushes must be pulled out quickly or the affected skin will turn septic. Stomach complaints and diarrhoea are very debilitating, especially because they cause a serious loss of body fluid. Food, drinks and ice should not be obtained from local vendors. Men with stomach ailments must report sick as soon as possible.
22. Flies are a perpetual source of irritation and infection. Only good sanitation can keep the fly menace at bay. Latrines should be sited well away from and downwind of camps and leaguers. Whereas on the move personal sanitation is a matter of taking a shovel to any cover which can be found, when in camp or leaguer for any length of time, deep trench latrines and 'desert roses', funnels dug into a sump to serve as urinals, are required. Sub-unit 'thunderboxes' are useful in semi-static operations. They can either be sited over a deep trench latrine or fitted with plastic bag containers which are emptied daily into a burning pit. If a burning pit has to be relit care must be taken to ensure that there are no smouldering remains before adding more petrol. Villages and bedouin camps should be avoided; they are often a source of disease and vermin. DET (diethyltoluamide) is an excellent insect repellent. It is issued in bottles and in sachets combined with sun cream for individual use. Camps can be

2. Canvas bags with a narrow neck and draw string. The slow evaporation of water through the canvas keeps the contents cool. The chagul issued to the US Marines during Operation GRANBY was more efficient than the old British pattern. Available on local purchase, and very popular in the Gulf, were the thermos style 'cool jugs'.

cleared of flies by spraying insecticides from vehicle exhausts or hand spraying machines. Mosquito nets can be chemically impregnated to give protection against sandflies.

Feeding

23. The initial effect of heat is to reduce the appetite so that the body uses up more calories than it ingests. This is inevitable and acceptable for a short period but a watch must be kept for those whose appetites do not recover so that they can be examined by the medical officer before their health deteriorates.
24. Boil-in-the-bag rations, like the old compo, provides a balanced diet, including enough salt. Extra salt should not be added without medical advice. There is no need for vitamin pills. However, packaged food becomes boring. The problem is exacerbated by the need to keep dispersed in the desert and consequently to cook on a vehicle basis. Anything an imaginative QM or staff sergeant can provide to make food more interesting is good for men's health and spirits. With a little flour and rice an enterprising cook can make the compo ration attractive. Fresh rations should be provided whenever practicable.
25. Flies and sand get into food causing gastric disorder. The need to keep rations covered from the moment they are taken out of the tin or unwrapped for eating cannot be overstressed. Plastic plates and cutlery are especially hygienic because they are disposable. Empty food cans and waste must be burned and buried as quickly as possible because they attract flies. Sub-unit communal burning pits should be dug when static. Flies must not be swallowed because they feed on faeces. There is a risk that a sizeable proportion of newly arrived troops in a tropical theatre will be afflicted by diarrhoea unless stringent precautions are taken. If, however, it does occur, with good hygiene the problem soon clears up. If the trouble persists, or if unusual symptoms break out in particular units or areas, the medical services must be alerted quickly. Investigation may reveal the source to be no more than a lapse in hygiene which can speedily be rectified. In the worst case it might be the first indication of a hostile bacteriological warfare campaign.

SECTION 2 - MORALE

26. Operating in the desert is tiring and, in hot weather, exhausting both physically and emotionally. Although the stresses and strains may be different from those endured in other extreme conditions, such as high mountains or jungle, the most important ingredient for success is the same, a positive state of mind. The desert is essentially neutral and the side which is better prepared and better able to adapt to it has an immense advantage. Soldiers who are proud of being 'desert rats' and have confidence in their ability to master the environment and turn it to good tactical use against the enemy have a clear lead over those who are not at home in, or even frightened of, the desert. Despite its harshness it has a compelling attraction and beauty.
27. The lack of natural barriers against surprise breeds a feeling of insecurity. The passive solution is a good surveillance system and alertness. The positive remedy

is offensive action to compel the enemy to dance to our tune. The necessity to carry out repairs and replenishment in the dark, the need to spend much of the night planning, giving out orders and, during a fluid battle, moving and fighting takes a greater toll of human endurance in the open desert than in most environments. Commanders, in particular, get very little rest in a ten or twenty day operation. Sleep is important. Tired commanders are less resolute and make mistakes. Weary soldiers are less brave and alert.

28. Good, imaginative, positive and sympathetic leadership is the key to high morale in desert operations, as in any other. To this add success in battle and sound administration. Inevitably, the latter will rely on resource and improvisation when supplies and stores go astray in the hurly-burly of a fast moving battle.
29. Situations vary. When the Army is successful and in the news, such as at the time of O'Connor's victory at Sidi Barrani and his advance across Cyrenaica in the winter of 1940/41, Montgomery's success at El Alamein and the campaign to liberate Kuwait in 1991, public support reinforced the boost for morale which follows victory. At other times the 'forgotten army' syndrome, the feeling that the efforts and sacrifices of the soldiers in a severe climate are not appreciated by an indifferent public at home, is corrosive of morale. Good PR, a force newspaper and reports on the theatre in the national and local press, which find their way to the front, are invaluable in promoting morale. Equally important is the need to keep troops as well informed as security will allow on the progress of operations. Lack of information fosters an uncomfortable sense of isolation in the open desert where an attack can materialize suddenly from any direction.
30. After good leadership, perhaps the most important elements in morale when troops are dispersed across the desert are the cohesion and loyalties within the small group such as the tank crew, the IFV section and the anti-tank guided weapon detachment. One man's lapse may jeopardize the whole group's survival. Discipline, especially self-discipline, and confidence in one's comrades' competence and dependability are priceless assets.

SECTION 3 - THE EFFECTS OF DESERT ON EQUIPMENT

Clothing and Personal Equipment

31. Although combat helmets are needed by dismounted infantry, sappers and towed gun detachments, as a protection against shell splinters and the showers of stones thrown up by shell bursts, they become hot and uncomfortable when worn for prolonged periods. Out of contact a soft hat with a brim to shield the eyes and neck is the most suitable headgear. Wide angle dark goggles or tinted glasses which do not block peripheral vision prevent eye strain and fatigue. They must be worn under the brim of a hat or combat helmet to prevent tell-tale reflection. Fine blown sand penetrates between even the tightest fitting goggles and the skin to irritate the eyes and cause conjunctivitis. Eyedrops are a useful antidote.
32. The cotton desert combat suit proved its worth during Operation GRANBY. Of the alternatives, loose shirts which absorb sweat, or cellular, which allow the body heat

to escape and sweat to evaporate, are also suitable for the desert. In very high temperatures the light cellular shirt is better. Trousers should be soft, hard wearing and cool. Denim is an excellent material. The temptation to smarten uniforms in a hot desert by making them close fitting should be resisted. The problems of wearing NBC protective clothing in a chemical environment are explained.

33. In cold and wet weather the standard, high combat boot provides useful support for the ankle on rough, rocky ground and keeps the sand out. In hot weather it is so uncomfortable that a desert boot has been designed to replace it. For better ventilation the trousers should be worn loose outside the boot unless there is a serious dust or poisonous insect problem. The rocky terrain is hard on boots and they wear out quickly. They also dry out and crack unless a non-greasy cleaner, such as saddle-soap, is used. More informal footwear, such as loose, ankle length boots, make for comfort out of contact. With the introduction of the desert boot there is no real need for other footwear, although some mounted long range reconnaissance units and irregular forces operating on foot in the gebel may prefer to wear them. If chaplis are worn without socks care should be taken to acquire a tan on the feet and ankles.
34. The carriage of personal equipment is subject to role and local improvisation. For the infantryman the standard 90 Pattern Assault Order may normally be worn, although privately purchased chest webbing is practical and popular. Tank and armoured reconnaissance crews may prefer the 'hand bag' approach of respirator and NBC kit fastened to a belt and stowed separately, wearing only their pistol harnesses. When not in action, or just about to be committed to battle, as little equipment as possible should be worn. On occasions when braces are not required to support equipment, the load should be carried entirely on a belt round the waist, not on the shoulders. The remainder should be stowed in the section IFV or APC or the detachment's vehicle. In winter a combat jacket, parka and gloves, in addition to a pullover will be required after dark. In wet winters, waterproofs will be needed. Bare skin must be covered from sandstorms. In blowing sand a scarf should be wound round head and neck, goggles should be worn and sleeves rolled down. Optical instruments, such as field glasses and watches, should be put into a plastic bag and tightly sealed at the neck to keep out the sand. Within reason, sartorial oddities are good for morale.
35. Protection against chemical weapons and nuclear fall-out presents a serious problem in the heat of the day because NBC suits would be stifling and remaining masked up extremely uncomfortable.

A and B Vehicles

36. ***Effects of Bad Going on Vehicles.*** The main source of damage to vehicles is rock, either loose stones and boulders or sharp ledges. Tyres become badly cut, whole pieces being torn out of them; they must be checked regularly and changed before failure. A higher scale of spare tyres is required in the desert than in a European theatre and crews trained and equipped for puncture repairs. Tank, IFV and APC tracks are easily thrown on rocky ground. Hydropneumatic and hydrogas AFV suspension systems are particularly useful in the desert. Normal vehicle springs and suspension systems are liable to fracture and damage with a consequent requirement for increased scaling. Other items which require constant checking are bevel and steering boxes, track wedge bolts, sprocket nuts and transmission shafts.

37. **Desertization of Vehicles.** The following points are relevant:

- a. Ideally, tanks, vehicles and other equipment should be modified for the desert before despatch from the UK. However, neither the vehicles accompanying a force sent overseas at the beginning of a campaign nor the replacements sent out for some time thereafter are likely to have been converted. Workshop facilities to desertize vehicles have to be set up in the theatre. Agreement should be reached between the Ministry of Defence and the force headquarters as to what modifications should be carried out in the factories, depots and workshops at home and the vehicle depots and workshops overseas. Nevertheless, there is one important modification which must be carried out before embarkation. Dust ingestion poses such a serious problem with tracked vehicles and helicopters that they have to be provided with adequate air filtration before they arrive in the theatre.
- b. *Modifications Required for Tactical Reasons.* Apart from the technical modifications required, the essentials are the reduction of silhouette and shadow definition, the removal or covering of glass to prevent the sun's reflection,³ the means to extract vehicles from soft sand and to ensure the survival of a stranded crew, and measures to defeat the wear and tear caused by grit.
- c. *Cooling Systems.* In very hot deserts armour and any other vehicle which does not readily allow a through draught should be fitted with a cooling system. Heat making equipment, eg, radios, need ventilation as well as the vehicle occupants. The cooling system should be designed to function well whether the vehicle is closed down or opened up. Air conditioner ductings should be insulated. Ducting must be checked for leaks and louvres must be kept clear.
- d. *Shade.* Vehicles which can be fitted with a double-skinned roof, allowing the air to circulate between the two layers, provide a worthwhile degree of protection from the sun's heat. When the tactical situation permits, a camouflage net backed with hessian, or any sheet of material slung sufficiently far above the vehicle to allow air circulation, will provide shade and lower the temperature inside the vehicle. If the material is allowed to droop in the centre over the vehicle it will increase the wind speed and the cooling effect in the same fashion as a bedou tent top.
- e. *Vehicle Colours.* All vehicles should be repainted in suitable desert camouflage colours, if possible before despatch overseas. Care should be taken to select the right colours. Not all deserts are yellow or brown. Some are predominantly grey.

38. **Desertworthiness as a Factor in Planning.** The state of preparedness of troops and their equipment for the desert is a significant factor in considering the timing, size

3. Glass should not be removed from fibreglass cabs because it is an integral part of the vehicle structure. Windscreens which either cannot be removed, or should not be for some other reason, can be shielded by fixing a camouflage net or face veil material sufficiently far from the glass to allow the wipers to work. Alternatively, glass can be smeared with a mixture of oil and sand.

and scope of operations they are able to undertake. It may be necessary to postpone an operation until both troops and equipment are in a fit state to execute it with a reasonable chance of success.

Heat, Light and Humidity

39. High Temperature.

- a. *Tyres.* Heat increases tyre pressures to dangerous levels and it is necessary to carry out checks in the middle of the day and routinely on long journeys to make sure that the safety limit is not exceeded. Consideration needs to be given to the reinflation of tyres on vehicles that do not have an integral capacity.
- b. *Fuel and Oil.* Fuel expands under heat and vehicle tanks should never be filled to capacity. Oils tend to thin out in the heat and engines need higher viscosity oils in the hot season.
- c. *Tank Gun Barrels.* In the morning the sun's heat expands the upper side of tank gun barrels while the lower half, in the shade, is only affected by the ambient temperature. Consequently the barrel droops slightly and until it has been warmed evenly by firing several rounds, shot tends to drop short. As the day wears on the heat reflected from the desert surface, particularly rock, expands the under side of the barrel but not necessarily to compensate for the sun's heat on the upper surface. The mismatch between gunsight and barrel can exceed 7 mils and result in a miss from an apparently perfectly aimed round. Such a disability could result in an enemy obtaining the first hit and loss of the advantage of surprise in a defensive ambush situation. The gun tube sleeve used in Europe is designed primarily to protect the barrel from moisture. A special thermal sleeve with a built-in compensator is a great asset in achieving a first round kill in the desert.
- d. *Spirit Levels.* Guns and instruments which rely on spirit levels for laying and sighting suffer from 'bubble trouble' in the heat.
- e. *Engines and Batteries.* Vehicle engines overheat in the summer but removing the side panels from the engine compartment is likely to cause air turbulence, making cooling inefficient and admitting sand. Electrolyte evaporates quickly and batteries lose their charge quicker in intense heat. Batteries must be kept topped up but not overfilled. Reserves of distilled water must be kept handy. Battery vents should be kept clear. Voltage regulators should be set as low as possible.
- f. *Radios.* The specifications for radios and associated communications equipment must continue to meet the stringent environmental standards if they are to work in the desert.⁴ If there is any doubt that communications and information

4. During UNTAG operation in Namibia, the current range of British radio equipment used by the UK Signal Squadron worked well in the heat of the Kalahari Desert. Other contingents which used military equipment not designed to the same rigorous standards or civilian radios experienced a great deal of trouble with their communications. However, even Ptarmigan suffers problems when the temperature rises above 33°C (91.4°F). More recently it has been noted on desert exercises that the reliability and range of current UK radios and equipment is poor.

systems equipment may be affected by extreme heat it will be necessary to obtain air conditioning units for any vehicle in which they might be installed. Other equipment may be insulated from the sun's direct rays with heat shields. Rechargeable batteries for manpack radios will have a reduced operating cycle because it is impossible to recharge them fully in very high or, indeed, very low temperatures. Maintenance-free batteries are a boon.

- g. *Tools.* Wood shrinks and becomes more brittle in the heat. The handles of picks and shovels are apt to break and axe heads fly off their handles. Wooden handles should be oiled or soaked in water periodically.
 - h. *Electronics.* Particular care has to be given to the cooling of electronic modules in the desert heat.
40. **Sunlight.** The sun's rays discolour clear plastic and eventually render it opaque. Sunlight also affects lubricants, pressurized gases and infra-red tracking systems. CO₂ systems must be protected from the sun.
41. **Humidity.** In hot deserts near the coast, for example around the Gulf, the humidity and dew cause rusting on bare metal, such as shock absorber arms. Fuel lines may have to be drained at night and in the morning. Humidity also causes fungi to grow on the inside of lenses in optical equipment. The remedies are regular but careful cleaning, de-humidifiers and air circulation where appropriate.

Dust and Wind

42. **Dust.**
- a. *Vehicles.* Grit gets into every moving part. Engines must be checked for excessive wear. Oil seals leak and must be replaced. Fuel must be filtered and air filters must be checked, cleaned, replaced regularly and properly seated. A mixture of dust, oil and condensation collects in the bottoms of hulls and sumps to cause control linkage problems. Engine oil must be replaced regularly. Grease must be pumped constantly in tank turret hydraulics to force out infiltrating sand. When moving drivers should avoid driving directly behind other vehicles to prevent ingestion of dust.
 - b. *Aircraft.* Helicopter turbine engines and rotor bearings are susceptible to sand ingestion and the resulting damage reduces engine life by as much as 66%. Sand filters must be fitted to prevent damage. The tips and leading edges of main and tail rotor blades must be taped to prevent scouring and erosion. Aircraft plexiglass must be covered when on the ground to prevent pitting as well as in the interests of camouflage. Regular washing with low pressure sprays is necessary to remove salt deposited by humid air near the coast.
 - c. *Lenses.* Optics must be kept covered from flying sand, lenses should be dusted down lightly with a camel hairbrush and then cleaned with a liquid lens soap. All abrasives must be removed before the final cleaning and drying with tissues, using the minimum of pressure.
 - d. *Weapons.* Soldiers must learn how to keep the sand out of weapons, infantry ones in particular. In dry weather small arms should be kept dry and oiled just

before going into action. Graphite is only used when there is no moisture in the air at all. Near the coast there is always some humidity and weapons should be oiled. Tank main armament should also be kept dry until action is imminent, when they, too, should be oiled. Tank guns must not be fired without oil. Gun muzzles and breach blocks must be kept covered out of action and the tubes cleaned thoroughly to prevent excessive wear and consequent inaccuracy in action. Similarly, missile rails must be covered and kept clean.

43. **Wind.** Apart from the damage caused by blown sand, which can strip the paint off vehicles, leaving them vulnerable to corrosion in humid coastal areas, the wind itself can be very destructive. In the khamseen season helicopter rotor blades, radio masts and anything liable to wind damage must be securely picketed. Fragile and vulnerable antennae should be taken down when a khamseen is imminent. Radar dishes should be covered. The working parts of weapons, muzzles and sighting systems must be protected in a dust storm. Tents should be struck over their contents and weighted down to prevent them from being blown away. Map boards should have canvas covers, as much to prevent maps from being ripped off as in the interests of camouflage.

Weapon Sighting Systems

44. **Direct Fire Weapon Visual Systems.** In the open desert the refraction caused by heat shimmer makes targets appear lower than they really are in spite of the impression given that they are floating in the air. On a cold night the situation is reversed, targets appearing higher than they really are. Corrections to the aiming point for tanks should therefore be made by aiming half a point up during the heat of the day and half a point below by night. For other visual weapon systems the appropriate correction should be made.
45. **Direct Fire Thermal Weapon Systems.** As previously mentioned thermal systems such as TOGS (thermal observation gunnery sight) are better for both target acquisition and engagement than image intensification.

Electrical and Communication Problems

46. **Static Electricity.** A combination of dry ground, rubber tyres and track pads prevent the natural earthing of static electricity. A metal circuit must be established between a bowser and the vehicle it is refuelling and both vehicles must be earthed during the operation. All switches should be turned off when refuelling and re-ammunitioning. Helicopter hooks must be lowered to the ground to release static electricity before loading and loads must be allowed to touch the ground before attempting to unhook. If not properly earthed a static electricity spark can ignite the helicopter fuel vapour.
47. **Electric Storms.** Thunderstorms blot out communications. Antennae should be taken down or disconnected from their radios before a storm. Operators should stand clear of equipment liable to be struck in a violent storm because aeriels and vehicles provide the best lightning conductors in the desert.
48. **Curvature of the Earth.** In very flat deserts, such as the terrain in northern Saudi Arabia and southern Iraq where there is no high ground on which to site VHF terminals, the curvature of the earth limits line of sight communications.

SECTION 4 - SURVIVAL NAVIGATION

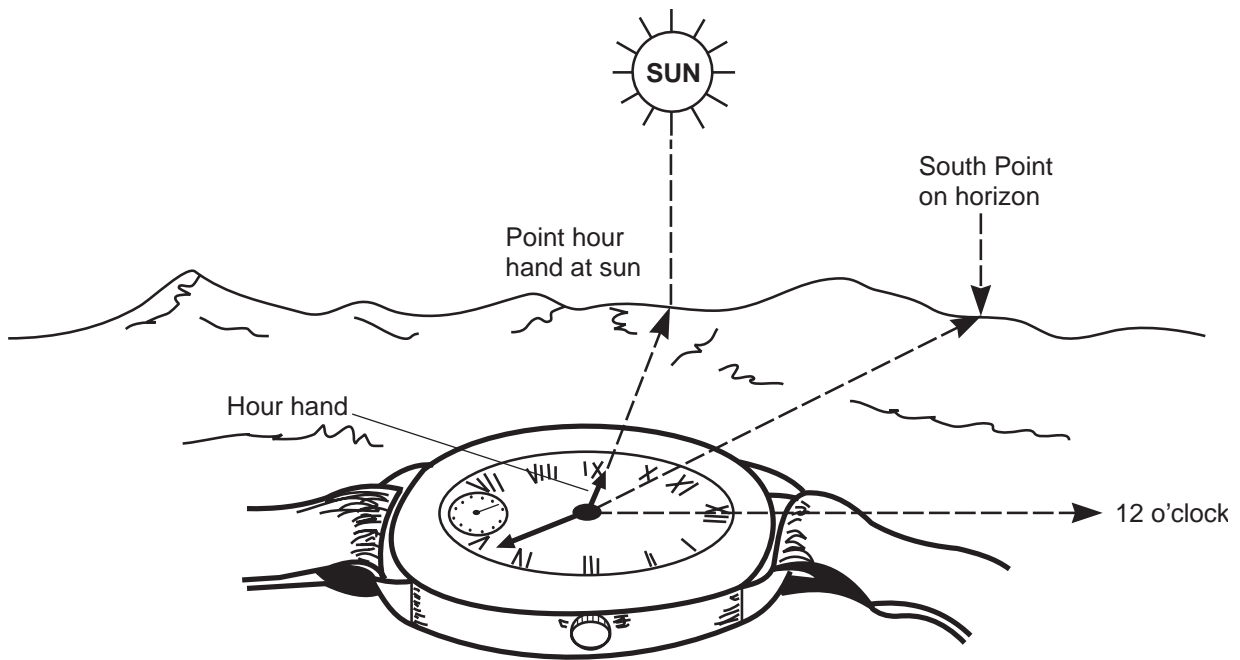
Basic Tools for Survival

49. If a vehicle breaks down or is involved in an accident an individual soldier may not have a GPS receiver but the following map reading and navigational equipment should be available:
- Map.
 - Compass.
 - Sun compass together with the appropriate shadow angle tables, time plates or cards and Davis's Azimuth Tables.
 - Protractor.
 - Ruler.
 - Pencil and rubber.
 - Binoculars.
50. However, in the event of an accident any or all of the above may be destroyed and a small party may, inadvertently, have left some of the navigating equipment behind. It is, therefore, useful to know how to orient oneself and navigate by the sun and stars. The methods will not give complete accuracy but are good enough in an emergency.

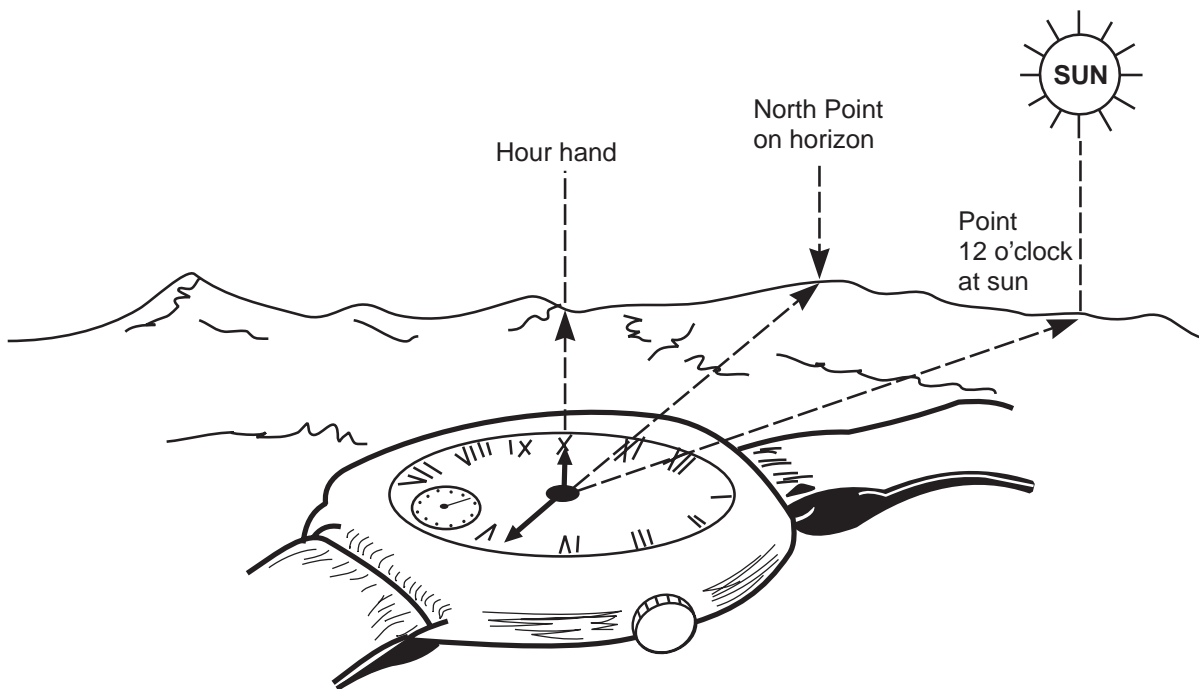
Finding South and North from the Sun

51. ***The Sun and the Seasons.*** North of the Tropic of Cancer ($23\frac{1}{2}^{\circ}\text{N}$) the sun is always within $4\frac{1}{2}^{\circ}$ of true south at midday. Similarly, the sun stays within $4\frac{1}{2}^{\circ}$ of true north at midday in the southern hemisphere, south of the Tropic of Capricorn. In the zone between the two tropics, astride the equator, the sun will shine from the opposite direction in the summer for varying periods, longer nearer the equator, quite short near the two tropics. Indeed, on the two tropics the sun will be directly overhead only at their respective summer solstices.
52. ***Using a Watch to Find South and North.*** This method is accurate, to within $4\frac{1}{2}^{\circ}$, an hour or so on either side of midday. Earlier in the morning and later in the afternoon it is only a rough guide.
- Northern Hemisphere.* See Figure 1-A.
 - Hold the watch horizontally and point the hour hand at the sun.⁵

5. Strictly speaking, local apparent time should be used by adding or subtracting 4 minutes for every degree the observer is west or east of local mean time (LMT). He should know if LMT is based on actual sun time over the local meridian or is an hour ahead of it and make the appropriate adjustment.



Finding South in the Northern Hemisphere using a watch



Finding North in the Southern Hemisphere using a watch

Figure 1-A Direction Finding Using a Watch

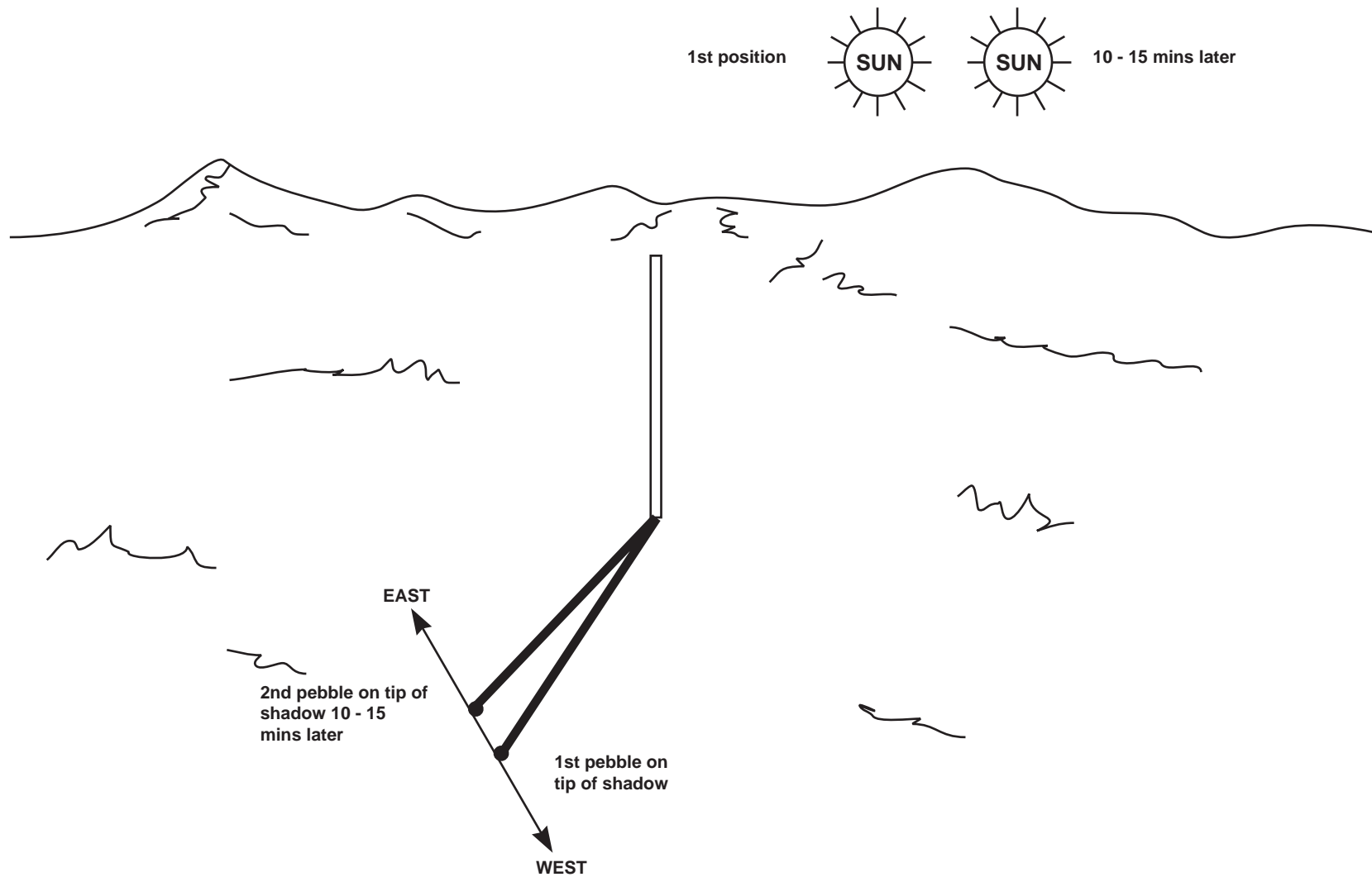


Figure 1-B Finding East and West by Shadow in Northern or Southern Hemisphere

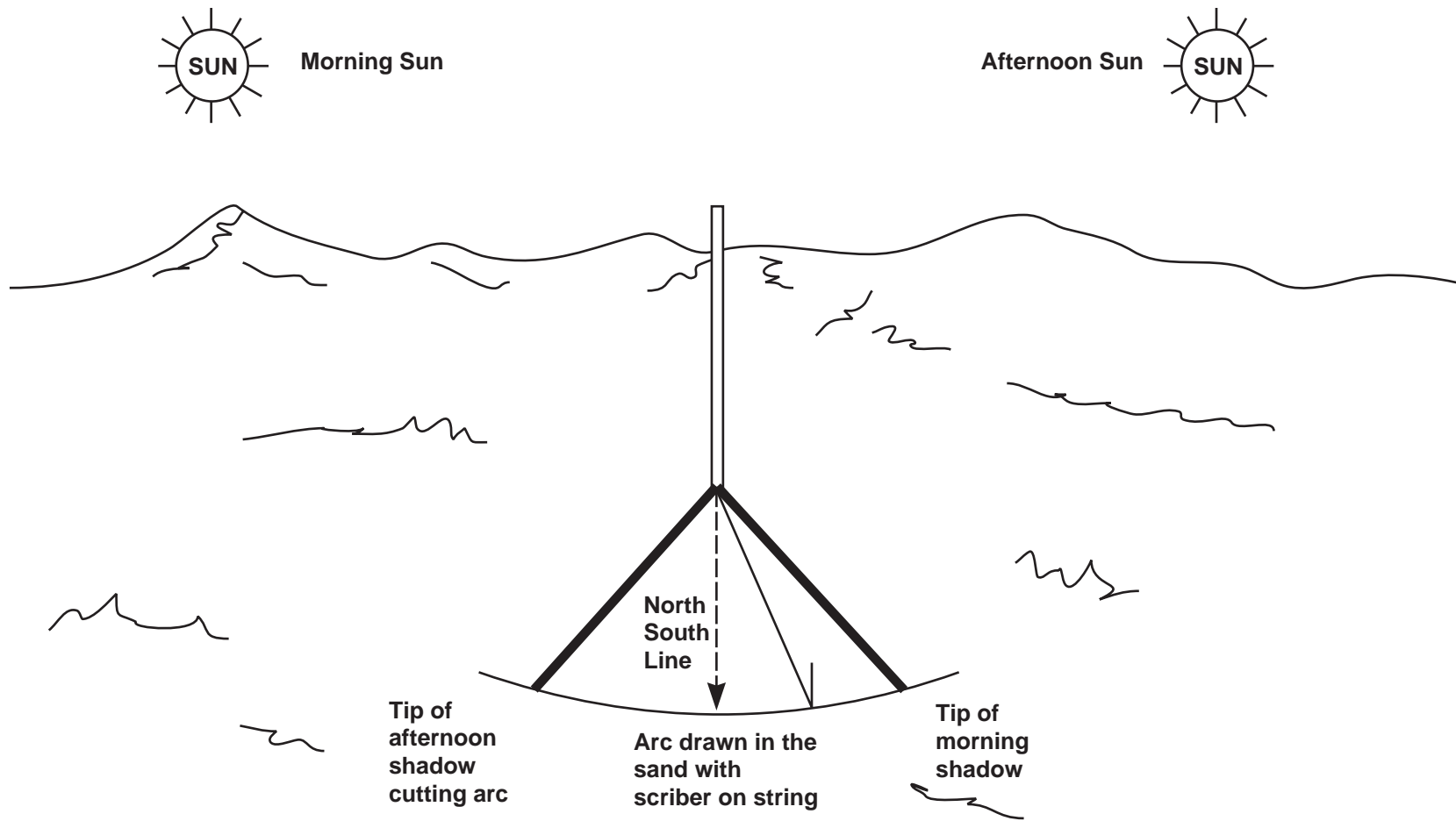


Figure 1-C Finding North and South in the Northern Hemisphere

- (2) Bisect the angle between the hour hand and 12 o'clock to find true south.
- b. *Southern Hemisphere.* See Figure 1-A.
- (1) Again, hold the watch horizontally, this time pointing 12 o'clock at the sun.
 - (2) Bisect the angle between 12 o'clock and the hour hand to find true north.
- c. *Within the Tropics.* Depending on the observer's latitude the sun will zenith in the opposite direction near the summer solstice. The sun may be so nearly overhead as to be virtually useless as a directional guide within an hour or two of midday. Where the sun casts a sufficiently long shadow remember to reverse the procedures for the two hemispheres.
53. **Use of Shadow.** A stick, preferably thin, straight and a metre long, should be placed vertically in flat ground, clear of any vegetation. It may be used to determine:
- a. *East-west.* Mark the tip of the shadow with a stone or stick. Ten to fifteen minutes later mark the tip of the shadow in its new position. A line drawn between the two markers gives a rough east-west line in the middle of the day. See Figure 1-B.
 - b. *North-south. Quick Method.* At midday the shadow will point north in the northern hemisphere and south in the southern (with the exception of the riders for the tropical zone mentioned earlier in paragraph 51). However, a watch set for local apparent time is needed for a reasonably accurate reading.
 - c. *North-south. Slow Method.* Tie a piece of string loosely round the bottom of the stick at one end and a piece of stick, a pencil, or anything that will make a mark in the sand round the other. In the morning, adjust the length of the string to the length of the shadow and draw an arc from the tip of the shadow round through north to the east. Mark the tip of the shadow with another stick or pebble. During the day the shadow will swing steadily eastwards, shortening as it approaches midday and lengthening again in the afternoon. When the tip of the shadow touches the arc drawn in on the sand, mark its position. Bisect the angle between the two markers to find the north-south line. See Figure 1-C.

Sunrise and Sunset Bearings

54. **Bearing at Sunrise and Sunset.** While the sun only rises due east and sets due west at the equinoxes, 21 March and 23 September, its bearing at sunrise and sunset for any time of the year and at any latitude, north or south of the equator, can be read off tables. A simplified version is given below (Table 1-D) showing the times of sunrise (in roman type) and sunset (in *italics*) at roughly 6½ week intervals for latitudes 0° to 40°N and S at ten degree intervals. The reading is correct for the moment the upper limb of the sun appears above or disappears below the horizon. Such factors as

atmospheric refraction and a horizon that is either not level or apparently raised by hills above the true terrestrial horizon may introduce inaccuracies of a degree or two but should not impair its usefulness as a rough and ready guide in an emergency.

Table 1-D Sunrise and Sunset Bearing Tables (Bearings given from True North)

Latitude North or South		0°		10°		20°		30°		40°	
		Sun- rise	set	Sun- rise	set	Sun- rise	set	Sun- rise	set	Sun- rise	set
Spring Equinox,	21 Mar	90°	270°	90°	270°	90°	270°	90°	270°	90°	270°
	6 May	74°	286°	74°	286°	73°	287°	71°	289°	69°	291°
Summer Solstice,	22 Jun	67°	293°	66°	294°	65°	295°	63°	297°	59°	301°
	6 Aug	74°	286°	73°	287°	72°	288°	71°	289°	68°	292°
Autumn Equinox,	23 Sep	90°	270°	90°	270°	90°	270°	90°	270°	90°	270°
	5 Nov	106°	254°	106°	254°	107°	253°	109°	251°	111°	249°
Winter Solstice,	22 Dec	113°	247°	114°	246°	115°	245°	117°	243°	121°	239°
	5 Feb	106°	254°	106°	254°	107°	253°	109°	251°	111°	249°
Spring Equinox	21 Mar	90°	270°	90°	270°	90°	270°	90°	270°	90°	270°

55. **Interpolation.** Sunrise and sunset bearings for dates and latitudes not shown on the table can be found by interpolation. For example, to determine the bearing of sunrise at Aba ad Dud, latitude 27°N, in northern Saudi Arabi, on 30 May.

a. From the table, Aba ad Dud falls between:

(1) Latitudes 20°N and 30°.

(2) Dates 6 May and 22 June.

b. The period between 6 May and 22 June is 47 days and 30 May is 24 days on from 6 May. For the purposes of this calculation 30 May may be regarded as being half way between 6 May and 22 June.

c. The sunrise bearings for the two dates and latitudes shown in the table are:

Latitudes	20°N	30°N
6 May	73°	71°
22 June	65°	63°

The difference between the bearings on the two dates at the same latitudes are

8° 8°

Because 30 May is almost halfway between the two dates the bearings at both latitudes will be

4°	4°
<u>65°</u>	<u>63°</u>
69°	67°

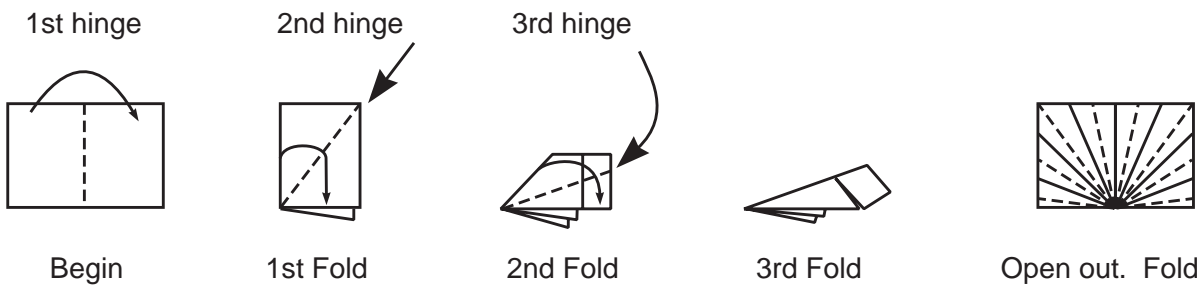
The difference between the two revised bearings is only 2°. Because 27°N is 7/10 of the way between 20°N and 30°N, or 1.4°, the sunrise bearing for 30 May at latitude 27°N is 68.4° or roughly 68½° east of True North.

Making a Rough Protractor

56. If the protractor has been lost in an accident one can be improvised from a sheet of paper, preferably a thin one which is easy to fold. See Figure 1-E.
 - a. First, fold the paper in half, left to right.
 - b. Next fold the left hand side of the doubled paper down to coincide with the bottom edge.
 - c. Then fold the top left edge down to the bottom edge again.
 - d. Unfold the paper. You now have creases at convenient intervals of 400 mils from 0 to 3,200 or less convenient intervals of 22½° from 0° to 180°.
 - e. The paper will not fold over easily again to subdivide the 400 mil or 22½° intervals still further. However, the paper can be opened out flat and each sector can be folded in half to produce further creases at 200 mil or 11¼° intervals.

The Stars

57. **Finding Polaris (North Star).** See Figure 1-F. Polaris is always within 2° of the northern celestial pole. It may be found by:
 - a. *The Pointers of the Plough (Great Bear or Big Dipper).* Extend the Pointers 5¼ lengths from the pointer at the top of the 'saucepan' (Dubhe). Polaris is easy to recognise at the end of the Little Bear constellation.
 - b. *Cassiopeia.* Draw an imaginary line at a fine angle between the centre and centre-right stars of the W and extend it 5¼ times the distance between those two stars to find Polaris.
 - c. *The Pointers, Polaris and Capella,* in Auriga, make a right angle.



Open out. Folds already made are indicated by straight lines. Subsequent folds on dotted lines can only be made with sheet of paper opened out flat

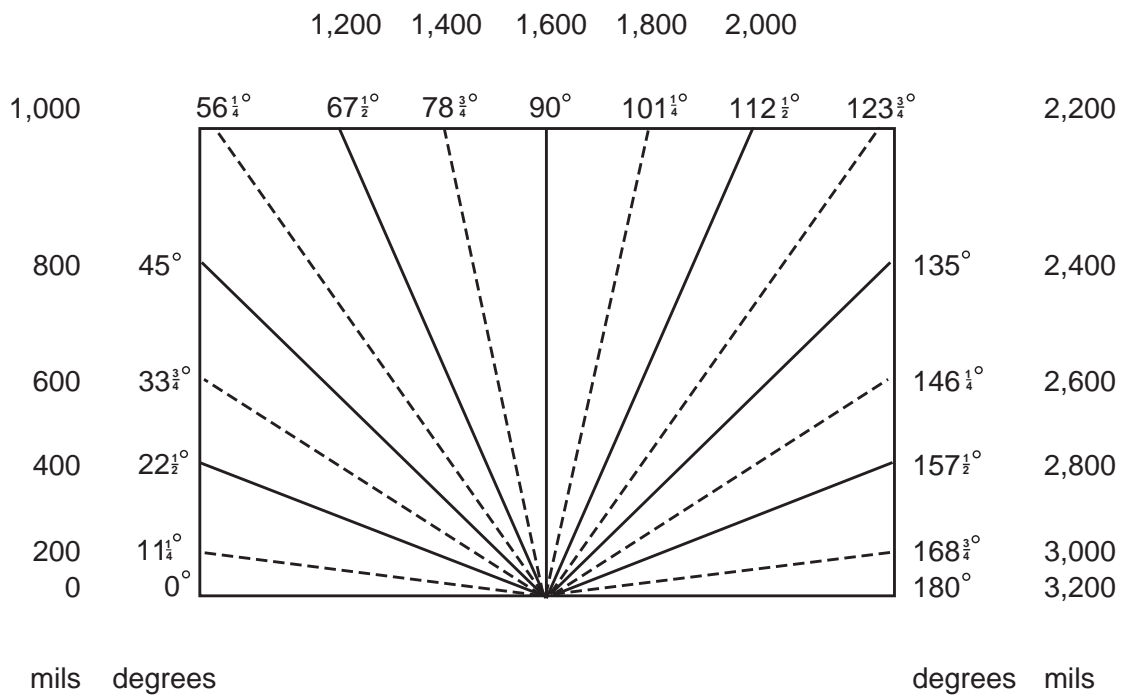


Figure 1-E Making a Paper Protractor

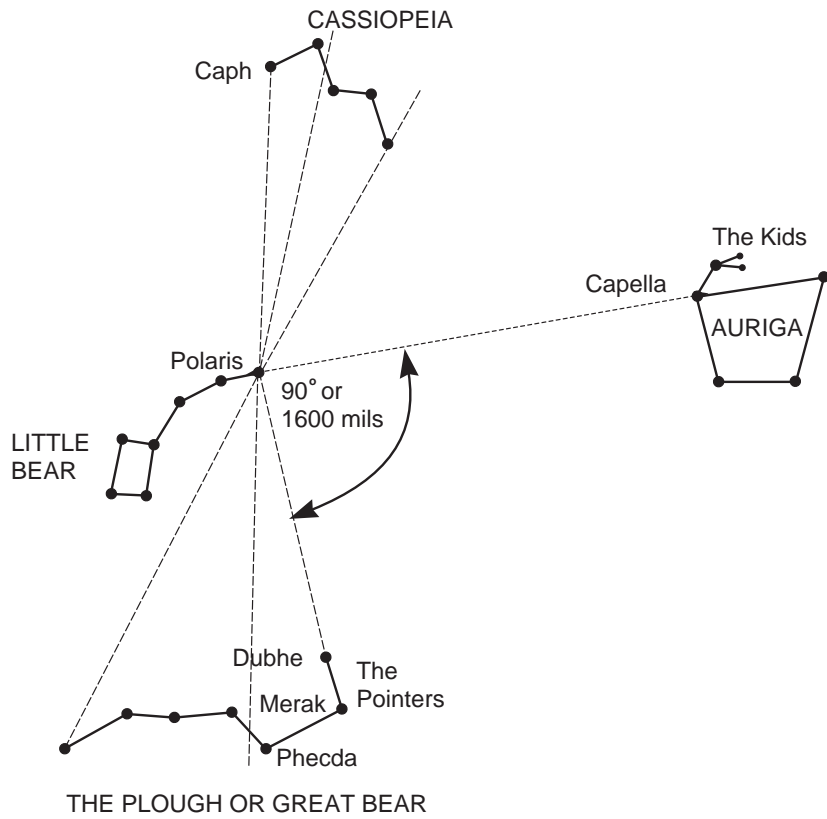


Figure 1-F Finding Polaris

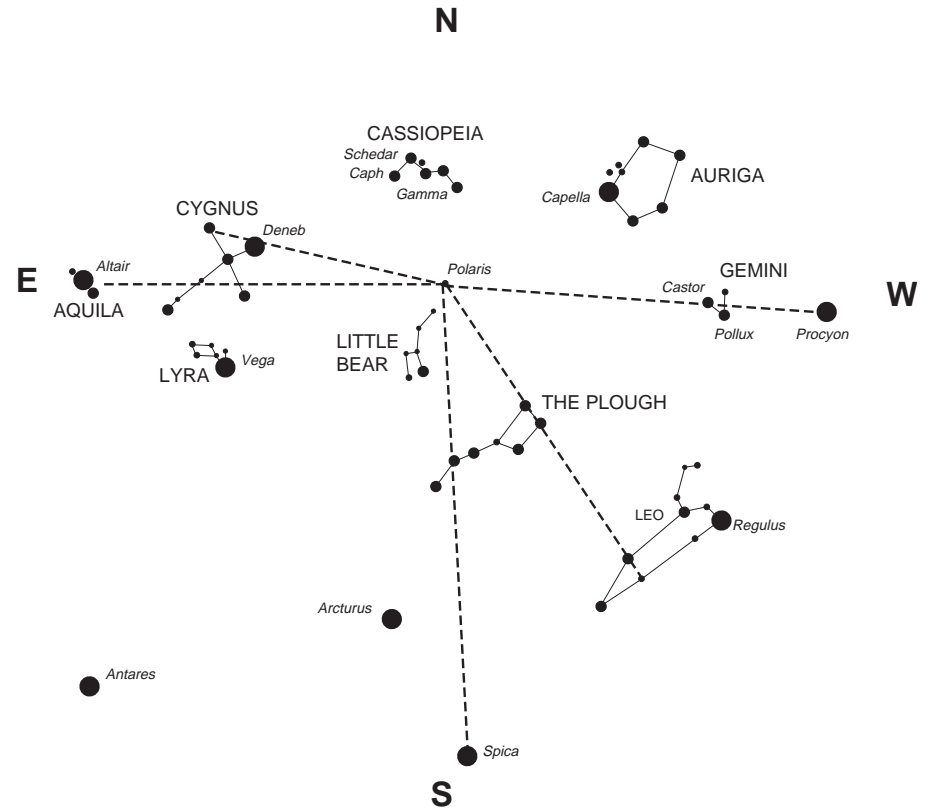


Figure 1-G Spring Sky
(Midnight 15 Apr Northern Hemisphere - 30°N)

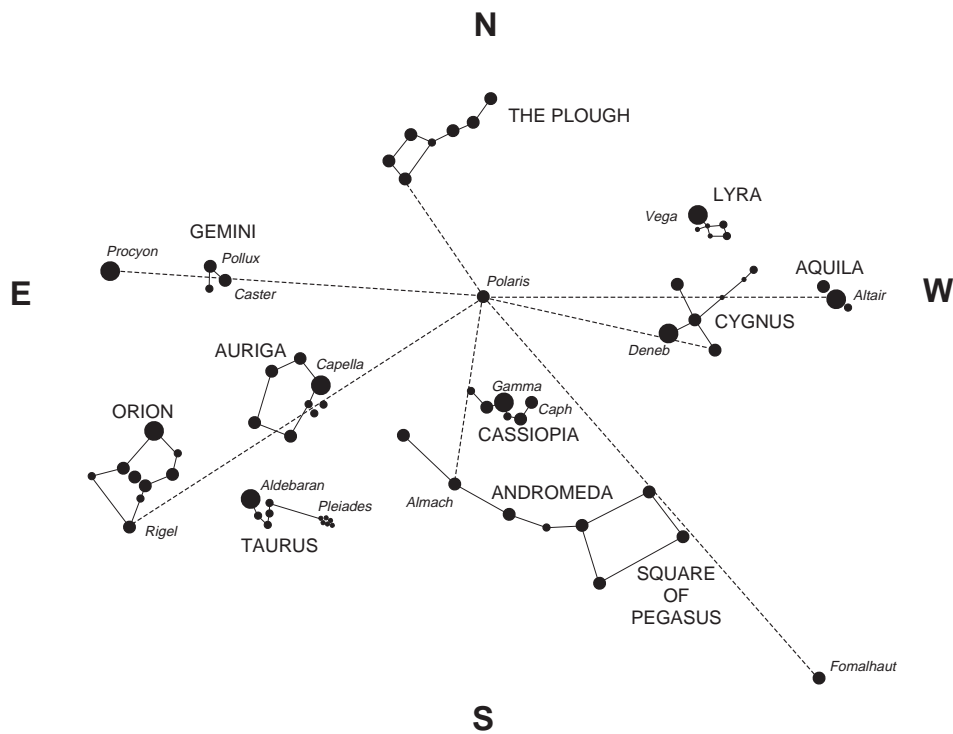


Figure 1-H Summer Sky
(Midnight 15 Jun Northern Hemisphere -30°N)

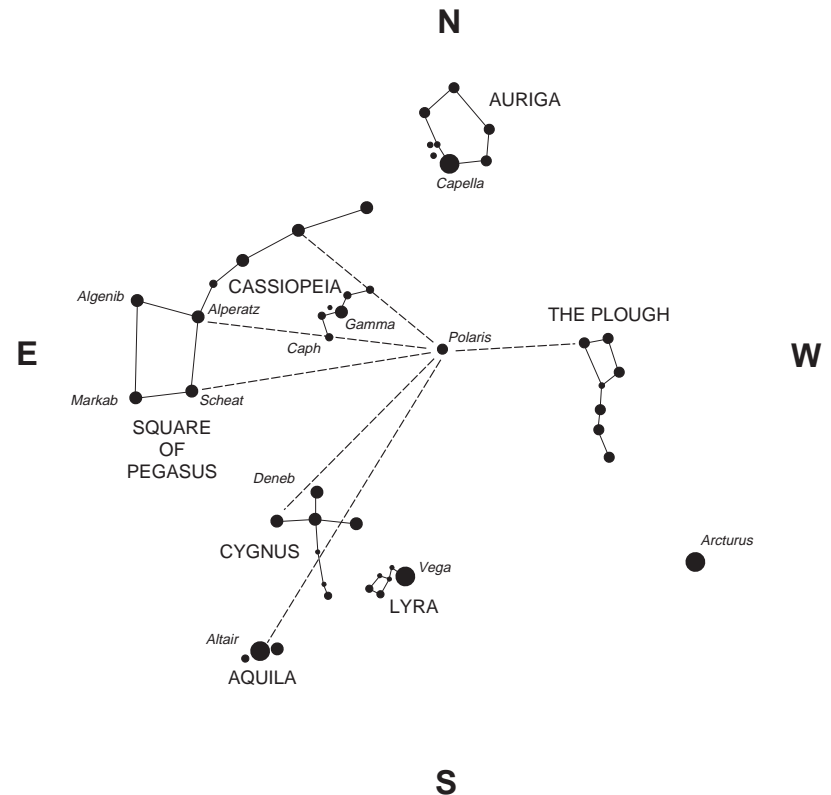


Figure 1-I Autumn Sky
(Midnight 15 Oct Northern Hemisphere - 30°N)

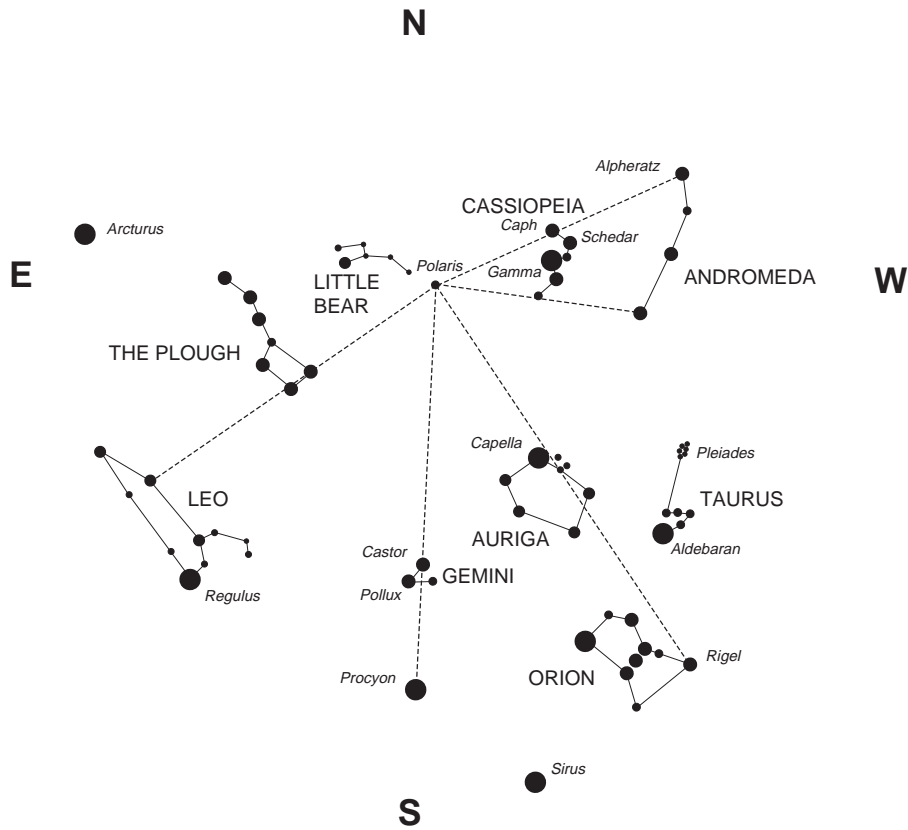


Figure 1-J Winter Sky
(Midnight 15 Jan Northern Hemisphere -30°N)

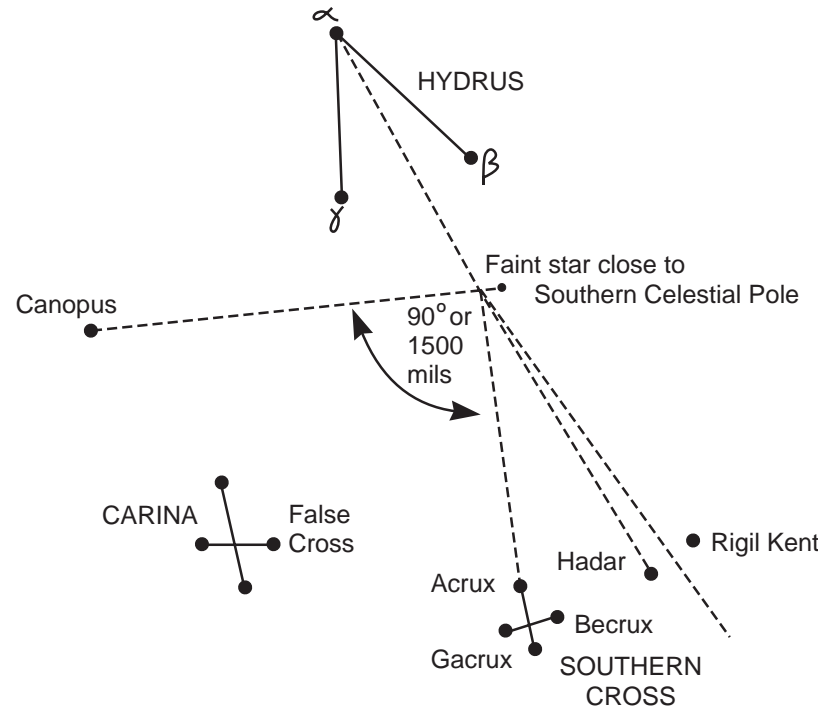


Figure 1-K Finding the Southern Celestial Pole

58. **Circumpolar Stars.** Although all constellations appear to rotate round the north or south celestial poles, some dip below the horizon for part or all of the night at certain times of the year. In the lower latitudes where the desert belts run it may not be possible to see both the Plough and Cassiopeia at the same time, all the year round, especially in the spring and autumn. Haze and dust may obscure stars close to the horizon. It is, therefore, necessary to be familiar with other constellation patterns.
59. **Seasonal Northern Hemisphere Constellation Patterns.** Alternative ways of finding Polaris, using a few additional stars and constellations, are shown in the following simple star charts for 30°N. The charts will be useful for 10° on either side of 30°N, a band which covers all the northern hemisphere's hot deserts.
- Spring. Figure 1-G
 - Summer. Figure 1-H
 - Autumn. Figure 1-I
 - Winter. Figure 1-J
60. **Finding the Southern Celestial Pole.** See Figure 1-K. There is no bright star at the southern celestial pole, only the faint one marked in the figure which is offset by about 1°. However, the pole can be found by:
- Extending the longer axis of the Southern Cross 4½ times.
 - Bisecting an imaginary line drawn between Hadar and Rigil Kent and extending the bisecting line until it meets the projection of the longer axis of the Southern Cross mentioned in sub-paragraph a. above.
 - Making an imaginary right angle by projecting the axis of the Southern Cross until it meets a perpendicular line reaching out to Canopus.
61. **Seasonal Southern Hemisphere Constellation Patterns.** Alternative ways of finding the southern celestial pole are shown in the accompanying diagrams for the four seasons:
- Spring. Figure 1-L
 - Summer. Figure 1-M
 - Autumn. Figure 1-N
 - Winter. Figure 1-O

Telling the Time by the Sun and Stars

62. **Sun Shadow.** If your watch is broken you can determine midday to within about a quarter of an hour by using the stick and shadow method described in paragraph 53c.

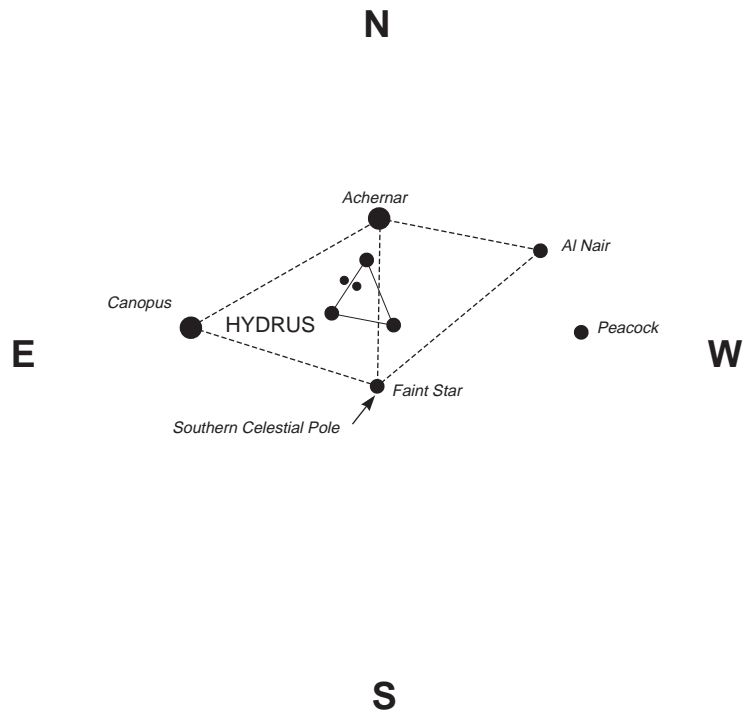


Figure 1-L Spring Sky
(Midnight 15 Oct Southern Hemisphere $-23\frac{1}{2}^{\circ}\text{N}$)

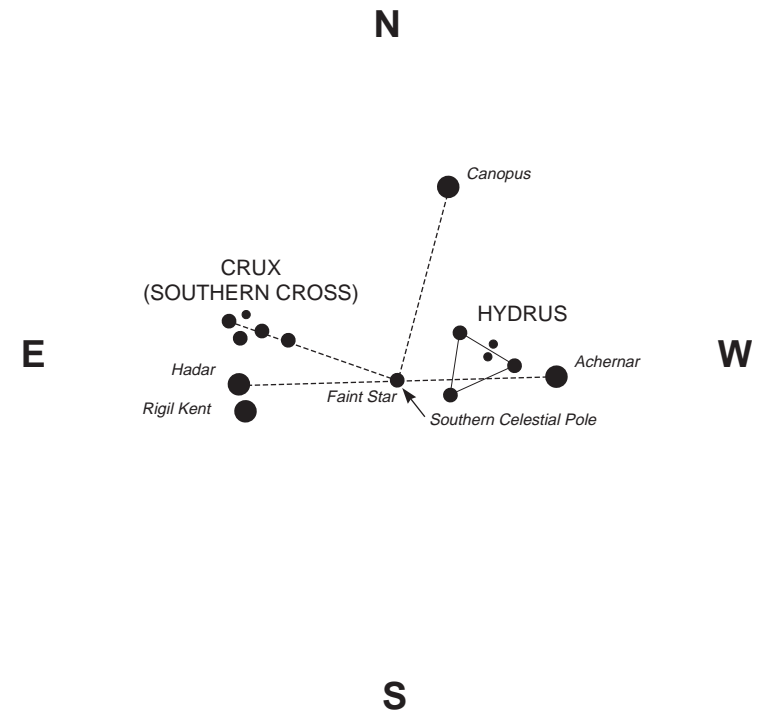


Figure 1-M Summer Sky
(Midnight 15 Jan Southern Hemisphere $-23\frac{1}{2}^{\circ}\text{N}$)

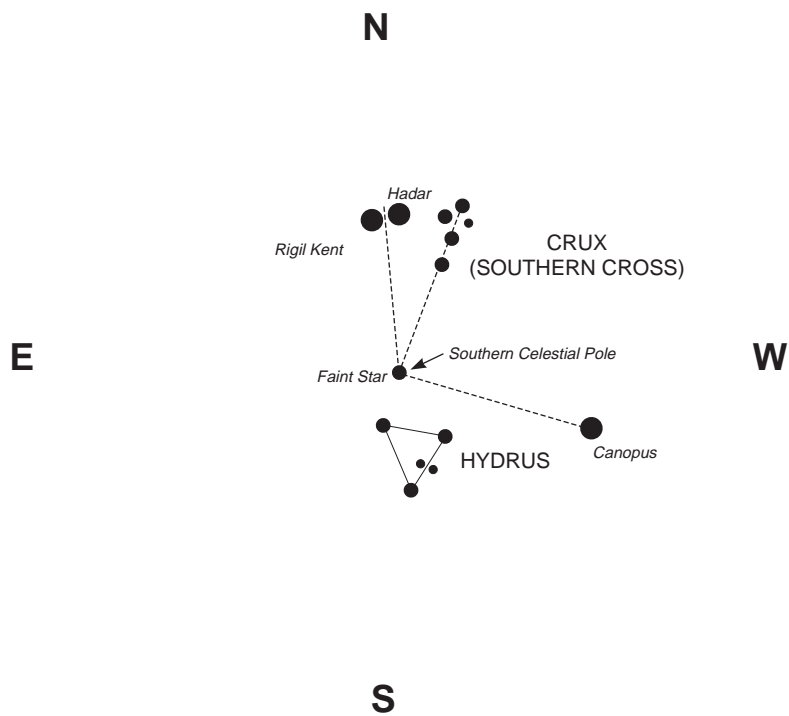


Figure 1-N Autumn Sky
(Midnight 15 Apr Southern Hemisphere -23½°N)

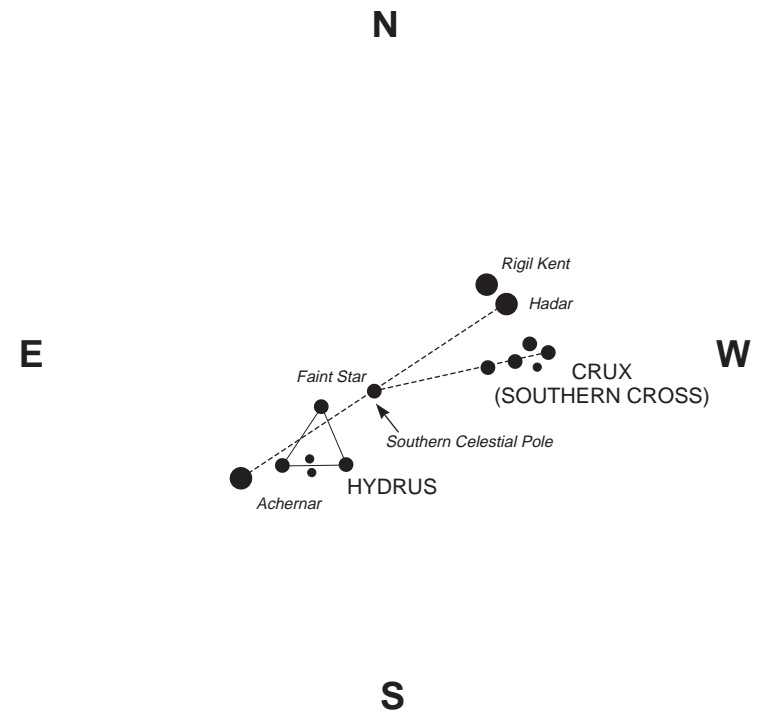


Figure 1-O Summer Sky
(Midnight 15 Jun Southern Hemisphere -23½°N)

The method is least accurate between mid-January and mid-March and again between the end of September and mid-December. In the middle of April and at the beginning of September the error is minimal.

63. **Tables.** If you have astronomical tables they will give sunrise, sunset and zenith timings. The figures in Table 1-D gives a rough and ready guide to sunrise and sunset timings.
64. **Relating the Stars to Time.** Stars can also be used to tell the time to within about a quarter of an hour of local apparent time (LAT) without the use of instruments. Just as a watch needs a point of reference from which to tell the time so does a star clock. The astronomical equivalent of the watch's 12 o'clock marker (also 0000 hours or 2400 hours) is the position of the sun in the sky at the spring equinox (the First Point of Aries) on or about 21 March. Using an imaginary line between an observer on earth and the sun as the celestial 0/24 hours mark the angular distance to any star can be measured. The angular measurement, east or west of this imaginary line, is the equivalent of longitude on earth but is called right ascension in astronomical parlance. Although the angular measurement can be expressed in degrees, like longitude east or west of Greenwich, it is usually stated in hours and minutes, clockwise in the northern hemisphere and anti-clockwise in the southern (because the observer is looking at the opposite side of the celestial sphere).
65. **Selecting Convenient Stars to Tell the Time.** A star which lies on the zero/24 hours right ascension line can be used to tell the time without any difficulty. Fortunately, there are two stars, one in the northern hemisphere, Caph in Cassiopeia, and one in the southern, Beta (β) in Hydrus, which are obligingly situated. Unfortunately, the two stars cannot be seen all the year round at desert latitudes. However, when they are out of sight it is possible to use other stars by making a simple correction to allow for their right ascension, the angular distance between the First Point of Aries and the star. For all practical purposes this is the same as the angular distance, expressed in hours, between the star and Caph in the northern hemisphere or Beta in Hydrus in the southern. The right ascension hour value becomes the basic figure from which calculations are made.
66. **The Star Clock.** By hanging an imaginary 24 hour clock on Polaris, or the Southern Celestial Pole, the hour value of the star can be read off as the next part of the calculation. The clock is marked counter-clockwise to allow for the earth's eastwards rotation. See Figures, which can be photocopied and taken into the field. The hours are given a *plus* value in the northern hemisphere and a *minus* value in the southern.
67. **The Westward Drift.** One further fact must be taken into account, the westward drift. Although the day measured by clocks and the sun is 24 hours long the star sphere rotates in a slightly shorter period, 23 hours and 56 minutes. This is because the earth is moving steadily in its orbit round the sun throughout the year so that the stars rise 4 minutes earlier each night. This accounts for the changing pattern of constellations in the night sky throughout the seasons. The westward drift can be allowed for in the calculation of time by giving each month a numerical value against the star clocks shown in Figures 1-P to 1-S.

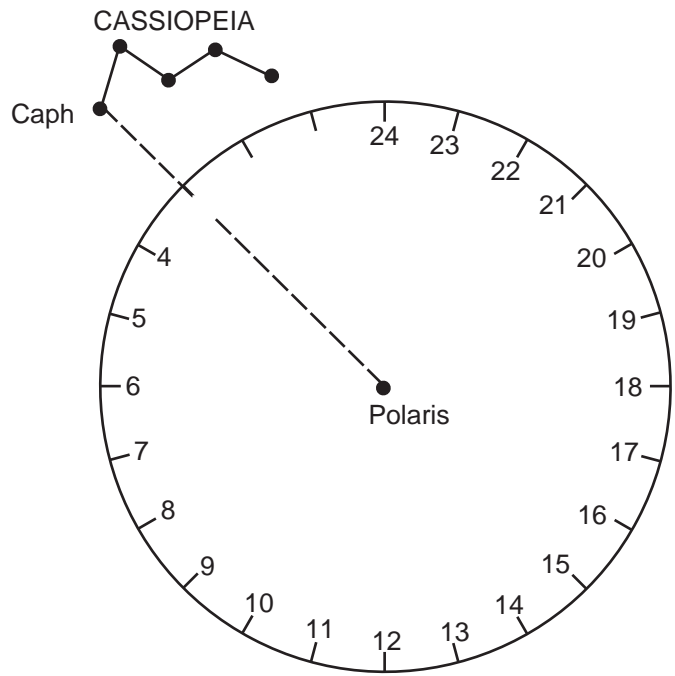


Figure 1-P The Cassiopeia Star Clock

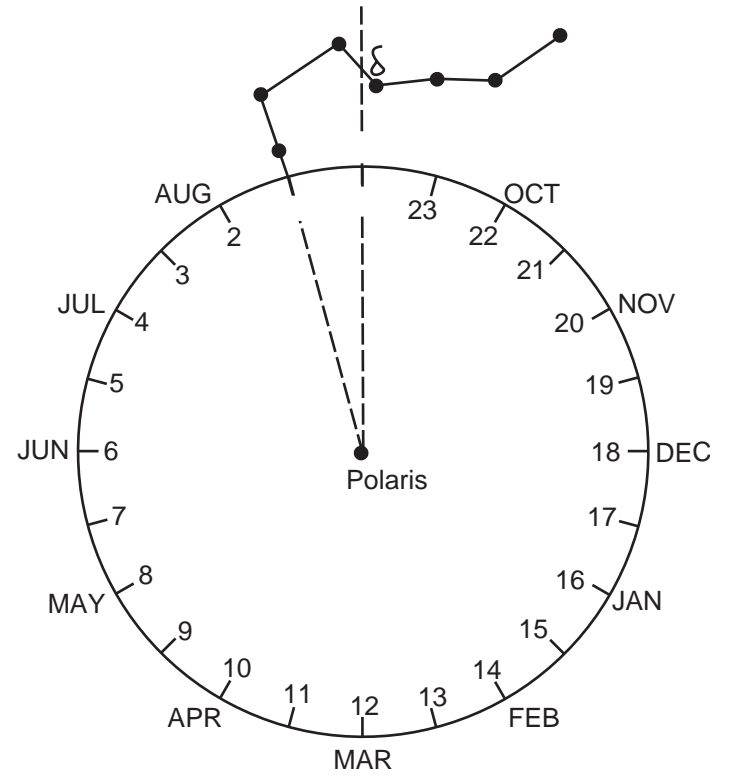


Figure 1-Q The Plough Star Clock

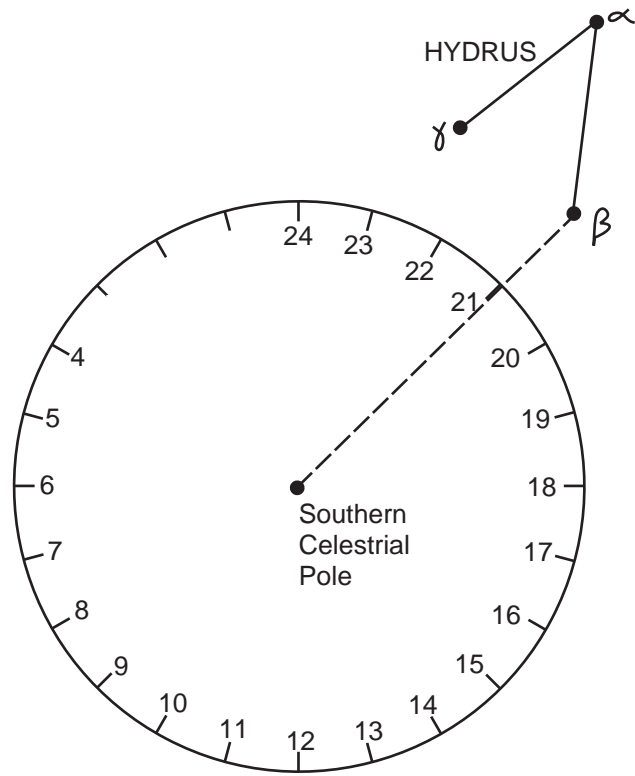


Figure 1-R The Hydrus Clock

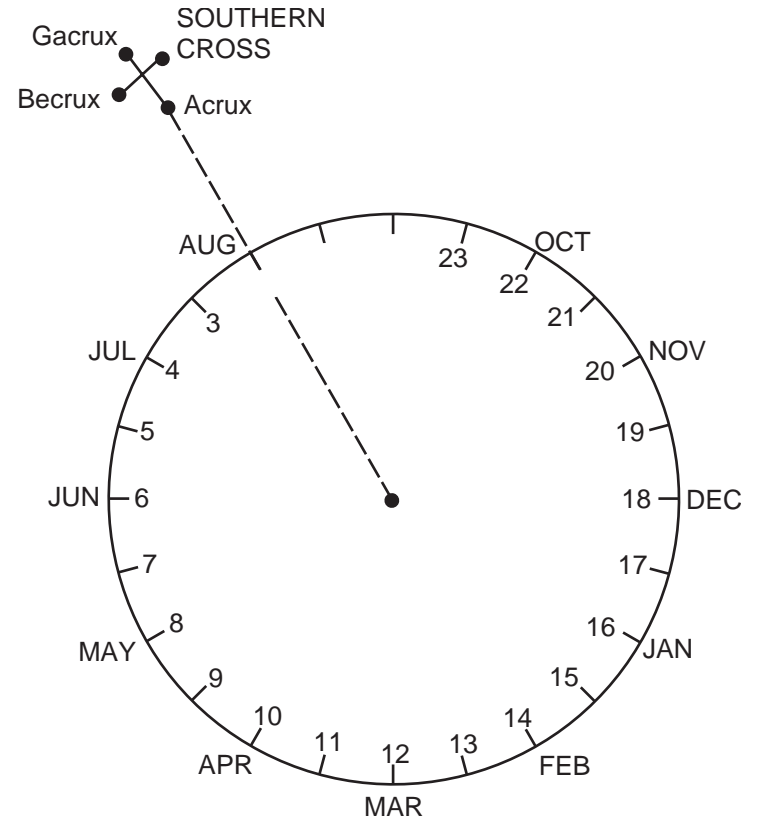


Figure 1-S The Southern Cross Clock

68. **The Cassiopeia Clock.** To use Caph, the right-hand star of the Cassiopeia 'W', to tell the time:

- a. Right ascension is 0/24 hours and can be ignored.
- b. Note the hour opposite Caph.
- c. Read off the hour number against the current month.
- d. Add the two figures together.
- e. If the total comes to more than 24, subtract 24 from it to arrive at the correct hour of the night.

Example. If, as in Figure, Caph points to 3 o'clock on 19 December:

Right ascension correction	0
Caph's clock hour	3
Mid-December	<u>18</u>
The time is	21 hours or 9pm

69. **The Plough Clock**

- a. *The Pointers.* The stars Dubhe and Merak of the Pointers form the hour hand but, because their right ascension is approximately 165° clockwise from Caph, a time allowance of 11 hours must be made. In Figure 1-Q the Pointers are at 1 o'clock on 18 April:

(1) Right ascension correction	11
(2) Pointers' clock hour	1
(3) Mid-April	<u>10</u>
(4) The time is	22 hours or 10 pm

- b. *The Other Side of the 'Saucepan'.* Alternatively, the two stars on the opposite side of the Plough's 'saucepan' can be used. An imaginary line drawn midway between Phecda and Delta (δ) to Polaris would pass through Caph in Cassiopeia if it was to be extended. This gives the mid-Phecda-Delta line a right ascension of 180° or 12 hours. Looking at Figure 1-Q again the sum would be:

(1) Right ascension correction	12
(2) Phecda-Delta clock hour	24
(3) Mid-April	<u>10</u>
(4) Sub-total	46
(5) Subtract 24 hours	<u>-24</u>
	22 hours or 10 pm

70. **Hydrus Star Clock.** Using Beta (β) in Hydrus as the hour hand when it points to 21 o'clock on 16 September in Figure 1-R:

- a. Right ascension correction 0
- b. Mid-September 24
- c. Beta clock hour (minus) -21
- d. Approximate time 3 hours or 3 am

No adjustment is required for right ascension because Beta Hydrus lies almost on the 0/24 hour line.

71. **Southern Cross Star Clock.** Acrux and Gacrux in the long arm of the constellation point to 2 o'clock on 15 March in Figure 1-S. The Southern Cross's right ascension is $187\frac{1}{2}^\circ$ from Beta Hydrus, reading anti-clockwise for the southern hemisphere, or $12\frac{1}{2}$ hours in terms of time:

- a. Right ascension correction 12 $\frac{1}{2}$
- b. Mid-March 12
- c. Sub-total 24 $\frac{1}{2}$
- d. Southern Cross's clock hour (minus) -2
- e. Approximate time 22 $\frac{1}{2}$ or 2230 or 10.30 pm

SECTION 5 - SURVIVAL SEARCH PROCEDURE

Survival

72. **Isolated Parties and Patrols.** Vehicles should never be detached singly away from the main body. Vehicles should only be despatched in pairs for short distances. For long journeys in the desert vehicles should be grouped in not less than fours so that the crew of a broken down or destroyed vehicle can be split up amongst the other three with their remaining rations and water. The survival, and other equipment to be carried in vehicles is listed in Chapter 3.

73. **Immediate Action When Lost or Broken Down.** If lost or about twelve hours overdue and out of radio contact, take the following action:

- a. If the vehicle is still mobile, move it to the nearest high ground. Display a flag, a white cross and arrange fluorescent panels to indicate your requirements using the International Ground/Air Visual Code or the more comprehensive Emergency Ground/Air Panel Signal Code. (See Annex C).

- b. If the vehicle has broken down, put out a flag on the nearest high ground and your white cross and fluorescent panels near the vehicle. A ground search party will the more easily see the flag and when it reaches the high ground it will see the vehicle and panels. When aircrew spot the panels they will readily pick up the vehicle.

74. ***Subsequent Action***

- a. Stay with the vehicle. Properly provisioned it is the only life support system. Only consider leaving it in the circumstance mentioned in paragraph 76 or as part of a well-considered escape plan.
- b. Erect shade, using the vehicle camouflage net, the hessian screen and the canopy, if it has been retained with the vehicle. If a recognition letter has been painted on it there is a better chance of being spotted from the air. To keep cool, use camouflage poles or sticks to raise whatever screening material there is sufficiently high to allow for ventilation. If possible, arrange the screening material in two layers with a space between them permitting the air to circulate to provide insulation from the heat of the sun.
- c. Stay in the shade and avoid all unnecessary work in daytime which will cause excessive loss of fluid through sweating.
- d. Wear light clothes by day to reflect the heat of the sun and to provide an insulating layer of air to keep out the hot air of the middle of the day and afternoon. A camouflage veil or a piece of cloth is useful as a keffiyeh to prevent sand getting into mouth, nose and ears. A pullover is essential to meet the swift drop in temperature at night.
- e. The senior rank should ration water and food on the basis of a week's stay in the desert and make a desert still, see Annex for details. If the materials to make a still are not available dew should be collected from non-toxic surfaces, such as Chemical Agent Resistant Material (CARM), but not from potentially toxic surfaces like metal. On the assumption that no anti-freeze has been mixed with it, coolant water from an engine may be drunk provided that it is filtered beforehand.

75. ***Attracting Attention***

- a. Prepare bonfires from scrub which can be lit as soon as an aircraft or vehicle is heard or sighted. Two bonfires should be built, 100 metres apart, to distinguish your fire from those of bedouin. If there is no scrub, use a 'Benghazi cooker'¹⁶ with petrol added to the sand for cooking and to produce a bright light by night, and with sump oil added to produce black smoke by day. A tyre will burn for a long time giving off black smoke.

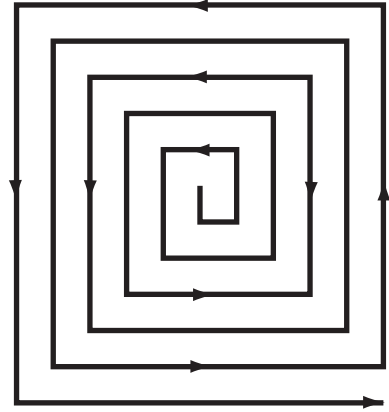
6. A rectangular or cylindrical tin with a large hole cut in its base and smaller punctures made in the sides between the middle and the top. The tin is then stood upright, upside down on a pile of sand soaked in fuel.

- b. If there is a transistor radio, listen for instructions from the nearest civil broadcasting station in peacetime. In war, tune in to the theatre forces broadcasting station. The mere fact that your disappearance has been noticed and that action is being taken to find you is a welcome morale booster in a nerve-racking situation. In war, formation staffs have to weigh up the advantages of encouraging lost parties by making an announcement against the disadvantages that a broadcast might jeopardize the security of an operation or lead to the party's capture by the enemy. It may be possible to send out a guarded message.
 - c. The senior rank should organize the men into shifts to keep a constant watch by day and night. On hearing or seeing an aircraft or vehicle, the following action should be taken:
 - (1) Light fires, using petrol by night and diesel by day to produce light and smoke respectively.
 - (2) Flash vehicle lights by night, if they still work, or a torch.
 - (3) By day flash a mirror at the aircraft or rescue vehicle. Mirrors in survival kits have directional aids. An ordinary mirror can be held in one hand and a finger of the other held upright in line with the aircraft or vehicle. By holding the mirror close to the eye and directing the reflection on to the fingertip the sun's reflected ray can be directed at the rescue aircraft or vehicle.
 - (4) Fire a Verey pistol or throw a smoke grenade.
 - (5) Fire tracer from a GPMG vertically into the air but not near enough to the aircraft to give the pilot the impression of hostility.
 - (6) Making a noise with vehicle horn, blank or live ammunition, rattling empty jerrycans, etc, when a ground party is observed.
76. **Stay Put.** Never panic. A tremendous effort goes into a desert rescue operation and people certainly be found provided they stay with their vehicle and do nothing stupid. A person or group should only contemplate walking out only if they know exactly where they are and are confident that they can navigate and have a compass, protractor and watch for additional aides. Physical strength and sufficient water are also major factors in any consideration about leaving the vehicle.

Search Procedure

77. **Ground Search.** Be methodical. Start by checking the lost party's planned route. From an estimate of the ground the search may take one of three forms. If there is a sand sea, or an area of soft sand, a quick check along the margin may find and extricate a group of bogged down vehicles. In flat desert, when few vehicles are available, a square search, starting at the last known position of the lost group, may succeed. If a large number of vehicles is available, institute a group search by lining

up the vehicles at intervisibility distance and moving forward steadily in line. Good control is necessary to maintain the integrity of the line and to make sure that any dead ground is properly examined. Either reserve vehicles should be given the task of searching dead ground or the whole line should be halted while the hidden area is reconnoitred. Ideally, control should be exercised by radio but if some vehicles are not equipped with a set, radio must be supplemented by flag signals.



A square search designed to cover flat desert.

78. **Air Search.** Air reconnaissance is the quickest and most efficient search method, particularly at night, when survivors will use some of the methods listed in paragraph 75 above to attract attention. Air photography can be useful in a training area in which there are few vehicles but on an old battlefield it may not be possible to tell the lost vehicles from battle casualties. In peacetime, police and civilian vehicles may show up on air photographs and have to be checked. The most serious difficulty facing an air search is an overturned vehicle because its underside is perfectly camouflaged from weeks of driving across sand and the crew may be trapped or unconscious. Helicopters are useful for investigating possible sightings and for searching the folds of gebel and broken ground.
79. **Overall Control.** Usually two control centres are needed:
- An air search control at the nearest air control centre.
 - A ground search control established on the spot. A good radio link between them is necessary to coordinate an overall search plan.
80. **Degree of Urgency.** Whenever any party is detached from the main body not only will it have sufficient water and rations to last at least a week but the amount, in terms of days? rations, will be recorded at the despatching headquarters. Should the party be reported overdue it will be possible to calculate how long it is likely to survive. This determines the urgency and amount of effort which should be allotted to the search. Because lost time can never be recovered it is better to act early and over-insure.
81. **Medical.** The nearest medical unit with resuscitation facilities must be alerted. The ground search party must include a first aid team. A helicopter should be placed on stand by to fly out to the lost group, especially if found by air search, and should include a doctor and medical equipment, including stretchers. Apart from suffering from exposure, dehydration and sunburn the party may have met with an accident and require instant evacuation.
82. **Recovery.** The ground search party must have a recovery vehicle and a REME element to repair or evacuate vehicle casualties.

SECTION 6 - ESCAPE AND EVASION

83. **Escape.** The distance a man can travel and the length of time he can survive depend on the amount of water he has with him or can get access to. A man's chances of making a successful escape are reduced the longer he remains a prisoner and the further the enemy takes him away from the battlefield. Although a prisoner should be allowed to keep his water bottle under the terms of the Geneva Convention an unscrupulous enemy may remove it in order to prevent escape. The best chance of making a successful escape is, therefore, early on during the confusion of battle, particularly at night and when a prisoner has the shortest distance to travel to reach the nearest friendly unit. Two men stand a far better chance of success than a man on his own. The support of companionship and the opportunity to discuss and weigh up courses of action and check navigation more than double the likelihood of success.
84. **Evasion.** A man or a party stand a far better chance of reaching the security of friendly troops if capture can be avoided by a timely decision to evade. The party may still have supplies of water, some rations, a map, a compass, a protractor and, with luck a vehicle with reserve cans of fuel. In the simplest case the party may only have to drive a short distance in one direction to reach friendly troops. Apart from avoiding enemy parties the next most serious problem will be identifying themselves to the first body of friendly troops they stumble into, particularly at night. In the latter case, it may be possible to get well clear of the enemy in the dark and then wait for dawn to approach a friendly position. If a long journey is in prospect, the best course may be to place a safe distance between the evaders and the enemy and then to stop, work out a plan, a route or direction to follow and ration the available water and food to eke them out for the length of time the journey is likely to take. In the confusion of battle and quick moves, vehicles and parties are apt to get lost, especially at night. The party is then in the same situation as an escaper but will have more opportunity to work out its position and plan its journey. As the more dehydrated one becomes the more one's thought processes become confused it is better to make the soundest possible plan early and then keep to it. In hot weather and when enemy parties are likely to be encountered it is better to move by night, using the stars to keep direction, and to lie up by day, concealed, in whatever shade can be found, or provided by a vehicle, in order to conserve water.
85. **Survival Navigation.** An escaping or evading party will be lucky to have a trained navigator together with his theodolite, sun compass, astronomical tables and a satellite navigation aid. Even without a map and compass it is possible to keep direction to within about 10 degrees or 280 mils, which may be sufficiently accurate if the friendly troops the party is moving towards cover a large enough area to compensate for perhaps double that error. How the sun and stars may be used for rough and ready navigation is explained in Section 4. If the wind blows from a predictable direction at certain seasons of the year this may provide a confirmatory check. However, the wind sometimes blows from a different direction at night, particularly near the coast. Such a shift should be readily apparent to anyone who has lived in the desert for some time but officers and NCOs should make sure that their men are aware of it.

86. ***Survival, Escape and Evasion Training.*** These are subjects which have to be covered when a unit moves to a desert for out of area operations or environmental training. Map reading, survival navigation, the necessity always to carry water and emergency rations on the person, how to make shade, construct a desert still and attract attention should all be covered in individual training. Fitness, an essential for survival, let alone escape or evasion, will come with the increasing tempo of physical training and marching during the period of acclimatization. Escape and evasion exercises should be held periodically, each one a little more demanding than the last but within the capacity of the troops' overall state of fitness and acclimatization. Armoured vehicle crews, gun detachments, drivers and all officers and men who are normally mounted must take part in fitness, survival and navigation training or they will have neither the stamina nor the elementary skills to survive, escape or evade in an emergency. Imaginative and taxing training will give officers and men confidence that they can survive in a hostile environment.

DESERT WATER TABLE

1. The table (Table 1-T) shows the number of days a man may expect to survive in the desert under two conditions in a range of temperatures, in Centigrade and Fahrenheit, and with varying amounts of water in quarts and litres:
 - a. At rest and staying in the shade. Top half of the table.
 - b. Marching by night and resting by day. Bottom of the table. This half of the table also shows the total distance a man may expect to cover.
2. Lack of water in the higher temperature ranges limits the individual's options to resting, erecting some shade and making signals and a bonfire to attract attention. It is not until a man has 4 quarts that his survival time increases appreciably or the option of walking out becomes a practicable possibility. Even with a large quantity of water available at the scene of the breakdown there remains the problem of how to carry it, remembering that 1 gallon weighs about 10 lb. However, if the mean temperature (approximately 15°F below the maximum temperature) rises above 80°F, marching at night increases the water intake requirement by 3½ pints per 24 hours.
3. Rationing sweat by resting in the daytime is as important as rationing water. Laying out signal panels and erecting shelter should be done as soon as possible to attract attention and provide shade. Heavy work, such as digging and constructing a still and collecting firewood, should be carried out in the cool of the morning or evening, or at night by moonlight.

**DESERT WATER TABLE
DAYS OF EXPECTED SURVIVAL**

Table 1-T

Resting in the Shade by Day, Minimum Essential Work at Night							
Max daily shade temp		Total Available Water per Man in Quarts (qts) and litres (li)					
		0 qts 0 li	1 qt 1.36 li	2 qts 2.72 li	4 qts 5.44 li	10 qts 13.6 li	20 qts 27.2 li
C°	F°	days	days	days	days	days	days
49	120	2 ½	2 ½	2 ½	3	3 ½	5 ½
43	110	3 ½	3 ½	4	4 ½	6	8 ½
37	100	6	6 ½	7	8 ½	11 ½	16
32	90	8 ½	9 ½	10 ½	12 ½	18	27 ½
27	80	10 ½	12	13	15 ½	23	35
21	70	12	13	14 ½	17	24 ½	38 ½
15	60	12	13	14 ½	17	25	38 ½
10	50	12	13	14 ½	17 ½	25	38 ½

Marching by Day, Resting by Night																
Max daily shade temp		Total Available Water per Man in Quarts (qts) and Litres (li)														
		0 qts 0 li			1 qt 1.36 li			2 qts 2.72 li			4 qts 5.44 li			10 qts 13.6 li		
C°	F°	days	km	miles	days	km	miles	days	km	miles	days	km	miles	days	km	miles
49	120	1	40.2	25	2 ½	40.2	25	2 ½	48.2	30	3	56.3	35	4	64.4	40
43	110	2 ½	40.2	25	2 ½	40.2	25	3	48.2	30	3 ½	56.3	35	4	64.4	40
37	100	3 ½	40.2	25	4	40.2	25	4	48.2	30	5 ½	56.3	35	6 ½	80.5	50
32	90	6	56.3	35	6 ½	56.3	35	6 ½	64.4	40	8	88.5	55	9 ½	96.6	60
27	80	8 ½	80.5	50	9	88.5	55	9 ½	96.6	60	11 ½	112.6	70	14	144.8	90
21	70	9	88.5	55	9 ½	96.6	60	11	128.7	80	12 ½	164.1	102	16	209.2	130
15	60	9 ½	96.6	60	10	112.6	70	11	161.0	100	13	209.2	130	17	289.6	180
10	50	9	112.6	70	10	144.8	90	11	193.2	120	13	289.6	180	17	289.6	180

NOTE. For ease of identification fractions are used for the total days of endurance and decimals for litres of water and kilometres. Miles and quarts of water are given in whole numbers.

DESERT WATER STILL

1. **Site.** Choose a site where there has been water, such as a wadi bed, a depression or a place where there is some vegetation and where the ground is easy to dig. The still should be located away from any shadow so that the sun will shine on it throughout the day.
2. **Construction.** Dig a hole about a metre in diameter and nearly as deep. Place a container in the middle of the hole. The container may be either a bucket or a bottle fitted with a wide funnel. Place a long rubber or plastic tube with one end in the bucket, or in the neck of the bottle between the glass and the funnel. This end should rest on the bottom of the container. The other end should be led out of the hole and placed in a mug or some clean receptacle.
3. **Plastic Sheet.** Place a sheet of thin, tough plastic, about 2 metres square, over the hole so that it forms an inverted cone, with its centre over the container. Make sure that the plastic does not touch the sand on the sides of the hole. Hold the sheet in position round the circumference of the hole with heavy stones and mould the sand to form a good seal between the sheet and the ground. Weigh down the centre of the plastic cone so that the inverted apex is about 5 cm above the middle of the container or funnel. The plastic sheet must have a rough under-surface so that the droplets of water which condense on it run down to the apex and drop into the container. Droplets fall off a smooth, shiny surface where they form, wasting most of the water. If only a smooth plastic sheet is available its underside must be roughened by rubbing it with stones or scouring it with sand.
4. **How it Works.** The sun's heat raises the temperature of the air and sand in the hole below the sheet until water vapour is produced. As the sun's heat raises the temperature in the confined space below the sheet, water vapour forms. When the air becomes saturated droplets of water condense on the underside, run down the cone and drop into the container. At night, when the air temperature drops sharply, the plastic sheet cools off while the ground underneath it remains warm. More water condenses on the underside of the sheet and drops into the container.
5. **Capacity.** A still of these dimensions will produce between $\frac{1}{2}$ and 1 litre in 24 hours. For this reason, all vehicles sent on independent missions must be fitted with a still so that as many as possible may be constructed in an emergency.
6. **Collecting Water from the Still.** The water may be sucked straight out of the container, using the rubber or plastic tube. If the lie of the ground is suitable the external end of the tube may be fed down into a bottle below the level of the container in the still so that the water can be syphoned down into it. Distilled water tastes flat but at least it is safe to drink.
7. **Treating Dirty or Impure Water.** Salt water may be obtained from lagoons near the coast. It is only potable when distilled. Pour the salinated water into the pit round the

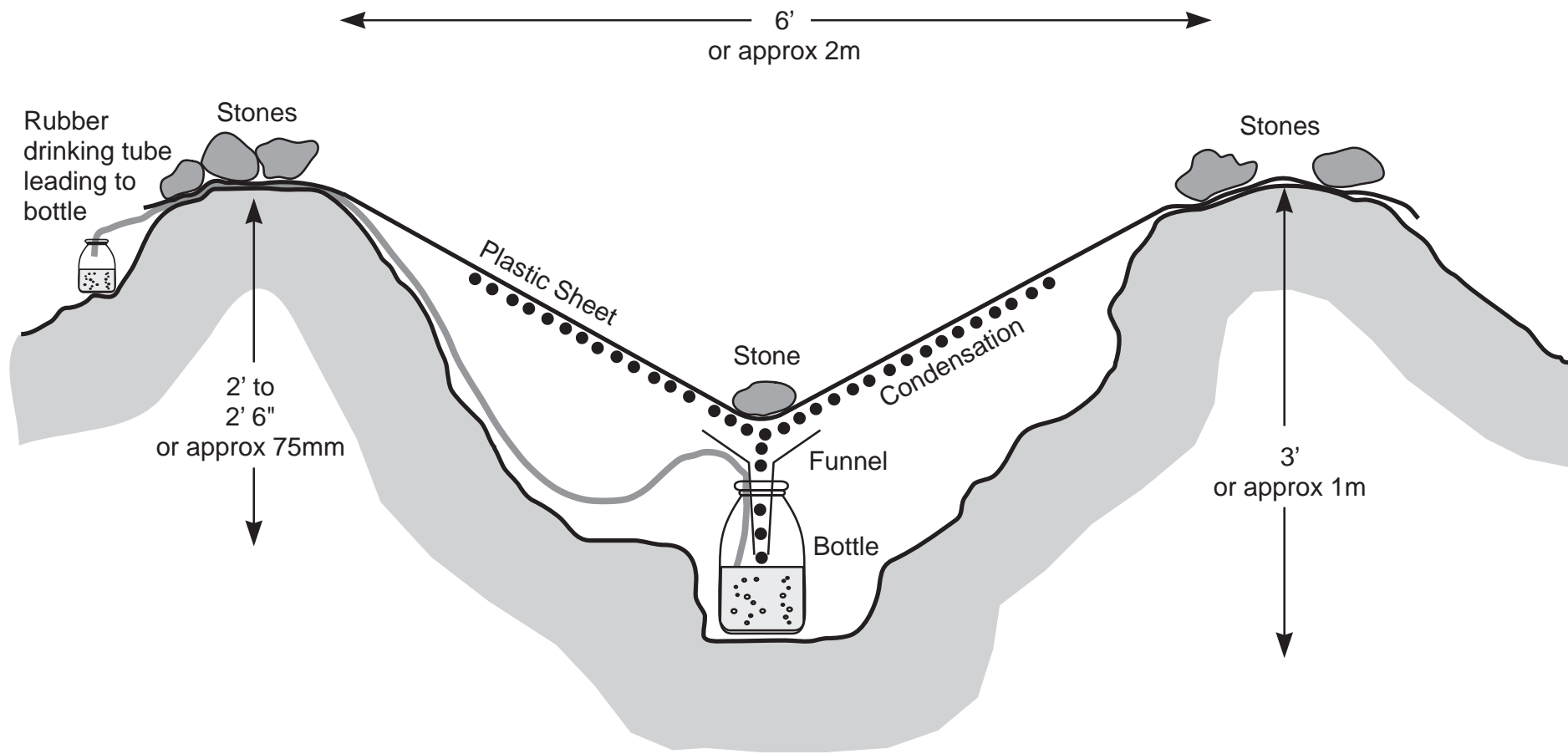


Figure 1-U A Desert Still

container. Some of the water will evaporate and then condense on the underside of the plastic sheet. Even urine can be treated in this way but never drink it undistilled.

8. **Food Trap.** Insects, small animals and snakes may slide down the topside of the plastic cone or burrow under the sheet and become trapped in the hole. The trap may attract a meagre but, to the hungry, a welcome addition to the rations.
9. **Rain Trap.** Near the coast, particularly in gebel, there is often a short but violent winter rainy season. The plastic sheet provides a ready-made rain trap.

EMERGENCY GROUND/AIR SIGNALS

Panel Codes

1. Although radio is the normal method of communicating between ground and air forces, an emergency system is needed in case small parties on independent missions meet with an accident or breakdown and their radios are damaged or their batteries run down.
2. The Basic Emergency Ground/Air Signal Panel Code for use by survivors and search parties is attached at Appendix 1.
3. The standard fluorescent panel is the most efficient visual signalling aid. If none is available, construct panels 12 feet by 2 feet (4 metres by 70 centimetres) from material which will take coloured paint and which does not tear easily in the desert wind. There should be as much of a colour contrast as possible between the material and paint used and the terrain on which the panels are to be displayed.

Smoke and Lights

4. White phosphorous or coloured smoke grenades and canisters can be used to attract attention by day and to indicate wind speed and direction. Care should be taken to place smoke downwind of a potential LZ or DZ to prevent obscuration.
5. At night, the quickest ways of attracting the attention of aircraft are to turn on any vehicle lights which still work, to shine an Aldis lamp in the direction of the aircraft or to fire Verey lights and tracer into the air. However, when an aircraft is close, care should be taken not to shine lights directly into the pilot's eyes at night, especially if there is a possibility that he is wearing NVG. To avoid ambiguity and the confusion of being mistaken for the enemy, tracer should be fired as soon as an aircraft engine is heard, ie, when it is still at a safe distance, vertically into the air and in regular bursts. It should not be fired near the aircraft because the pilot might misinterpret the distress signal as a hostile act.
6. The standard coloured signals for ground to air communication are:

<u>Colour</u>	<u>Meaning</u>	<u>Remarks</u>
Green	Clear	
White	Hold or Wait	White is also used to indicate your position.
Red	Do not	

7. If it is possible to obtain small strobe lights, goosenecked flares or to improvise other kinds of light signals they may be laid out at night in the panel code patterns. However, it may be sufficient to use light signals to identify a lost party to friendly aircraft at night and to use panels after sunrise.

Notes to Panel Code Opposite.

1. Symbols should be at least 3.6 metres (12 feet) long and 0.6 metres (2 feet) wide. They should be as conspicuous as possible, their colour contrasting with that of the colour of the ground.
2. Spacing between symbols should be half the length of a panel.
3. Ideally, symbols should be made up from fluorescent panels, strips of fabric or parachute materials. If no such material is available panels can be improvised from wood, stones, sheets of metal, by staining the surface with oil or by trampling the sand.
4. At night, lights or flares should be laid out in the same pattern as the symbols.
5. Smoke, flares or light reflected from mirrors or glass should be used to draw the attention of aircrew to the signals.
6. Air-Ground Signals:

The following signals from aircraft mean that the ground signals have been understood:

- a. By day - rocking the wings.
- b. At night - flashing the landing or navigation lights twice.

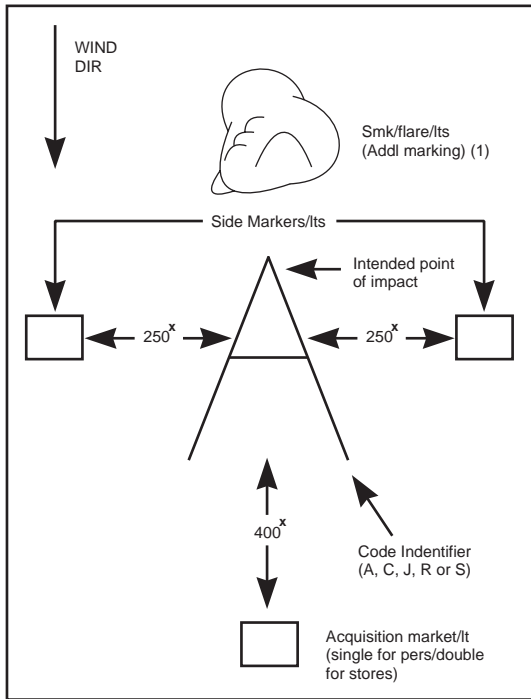
Lack of these signals indicates that the ground signals have not been understood.

BASIC EMERGENCY GROUND/AIR SIGNAL PANEL CODE

- The following signals will be used in military operations in an emergency to convey information to an aircraft. Commanders may prescribe the use of appropriate identification signals for use in conjunction with the code in their own theatre of operations if necessary.
- Items marked with an asterisk (*) are incorporated from the International Ground/Air Emergency Code contained in ACP 136.

F	∨	I	II	T	XXX	XA	!
Require food and water*	Require firearms and ammo*	Require doctor serious injury*	Require medical supplies*	Land in this direction (Direction from base to head of T)*	Cancel supply drop*	Cancel Air Strike*	Require signal lamp with battery and radio*
III	E	EA	E↑	∥	!"	X	↑
Casualty requiring immediate evacuation*	Ground Party in action with enemy*	Enemy attacking or preparing to attack (from direction of Apex of 'A')*	Target of opportunity in direction shown*	Require radio with batteries*	Required radio batteries*	Unable to proceed*	Going in this direction*
E²↗	△E	E↗	EX	N	□	L	JL
Request air support in direction of arrow. Number = 100s of m. Each bar = 25m.	Enemy in possession of landing ground*	Enemy concentrated in direction indicated. Not in contact*	Enemy withdrawal	No*	Require map and compass GPS*	Require fuel and oil	Not understood
IU	U	UI	△	LL	K	□	I>
I have a message for you*	Message received*	Are you receiving my signals*	Probably safe to land here*	All well*	Indicate direction to proceed*	Aircraft badly damaged*	Will attempt take-off*
△	△	H	TZ	W	XN	Y	
Temporary Landing Delay*	Do not land here*	Helicopter Touch Down*	Drop Here*	Require Engineer*	Nothing more to communicate*	Yes*	

EMERGENCY DZ LAYOUT



Note:

1. Do not allow smk to obscure DZ. Colours:

- a. Green. Clear to drop.
- b. Red. Drop cancelled. NO DROP.
- c. Yellow/White. Drop temporarily postponed. WAIT.

DZ CONDITION MARKINGS

MEANING OF MARKING	DAY (PANELS)	NIGHT (LIGHTS)
'CLEAR TO DROP' (IDENTIFIER CODE MAY BE A, C, J, R or S)		
TEMPORARY CLOSING OF DZ 'DROP POSTPONED' (WAIT)		
EMERGENCY-DROP CANCELLED 'NO-DROP'		

CHAPTER 2

MOVING IN THE DESERT

SECTION 1 - NAVIGATION

Systems

1. **Satellite Navigation (SATNAV) Systems.** SATNAV provides accurate coordinates of one's position and altitude. It also indicates a course to steer. It allows a commander to plan a long move by day or night with complete confidence. In conjunction with lasers it provides an invaluable aid to the engagement of targets by artillery, armed helicopter and close air support. A commander has only to order a course to steer, speed of advance and destination and the leading sub-unit will guide the unit. Over reliance on GPS must be avoided. It can result in vehicles following bearings blindly. This leads to crashes and vehicles bogging in or ignoring what is marked on the map. GPS is an aid to navigation and not a replacement for it. There is, however, still a need for a simple 'lost procedure' for all ranks which needs briefing and explanation before operations start.
2. **Basic Navigation.** It is still necessary to master the basic skills in order to select a route off the map, monitor progress, react to changing tactical situations and to provide an alternative method in case of damage to SATNAV receivers, unserviceability or interference with the satellites or their signals by a sophisticated enemy. Very shortly there will be no gaps in the SATNAV system. Soon there will be sufficient satellites above the horizon to offer continuous coverage.¹ The sub-paras a. to c. below give some hints on basic navigational skills should they be needed.
 - a. **Navigation Dismounted.** On foot, navigation can be extremely accurate using a combination of magnetic compass and pace checking in the absence of a hand-held GPS receiver.
 - b. **Navigation in Vehicles.** Mounted, an accurate speedometer is sufficient to establish distance travelled. The officer or NCO responsible for guiding the unit should have the vehicle with the most accurate speedometer and preferably one which measures tenths of kilometres or miles. On long distance moves the average between three reliable speedometers should be used. Except for straight runs over flat good going, ordinary magnetic compasses are virtually useless in vehicles, even if mounted between iron spheres. The magnetic effect of the constant changing of the engine revolutions in low gear combined with the variation in the relationship between the vehicle's magnetic field and the earth's every time the vehicle turns makes for gross inaccuracies. If a magnetic compass has to be used the user must dismount and get well clear of the vehicle's magnetic field, eg 75 metres from a tank and 10 metres from a dannaert wire fence, before he takes a bearing to the next landmark, a time-consuming and irritating process. The officer or NCO leading the unit must keep a movement log and map plot.

1. During Operation DESERT STORM in the campaign to liberate Kuwait there were 30 minute periods each day when insufficient satellites were above the horizon to obtain a position fix. Many units chose not to move during these periods. When the last of the 24 satellites (21 operational and 3 reserve) is placed in orbit, hopefully in early 1994, there should be no more gaps.

- c. *Sun Compass.* In the absence of SATNAV, the best aid to driving on a given bearing is a sun compass. If a sun or magnetic compass and vehicle speedometer have to be used for a long move it will be necessary to establish one's exact position periodically with a theodolite.
3. **Mapping and Navigation.** See Annex A for brief notes on navigation systems and mapping facilities.
- 4.. **Describing Ground and Briefing.** Allied to the problems of navigation and map reading is the difficulty of pointing out the ground to a visitor at an OP, a commander making a reconnaissance and the members of an O Group. Maps may seldom provide enough detail for briefing and the issue orders. An air photograph or satellite imagery provides a useful aid for planning purposes.
5. **Surmounting Obstacles.** Another essential aid to mobility is the forethought needed to position suitable engineer equipment near the head of a column where it can be called forward quickly to deal with the inevitable natural obstacles, such as steep-sided wadis and patches of soft sand, infrastructural impediments to movement, such as surface pipelines, and to improve routes through defiles which have been cut up by the passage of large numbers of vehicles. Equally important is the availability of rapid mine-clearing devices to deal with minefields. Other artificial obstacles which may be encountered are anti-tank ditches and fortifications constructed by bulldozing sand into steep banks. Both may be protected by mines. Where movement is likely to be canalized a traffic control system must be on hand to control vehicle flow and organize diversions.² Vehicle axis signs are usually mounted on long angle-iron pickets so that they are readily visible to drivers.
6. **Cross-Country Mobility.**
 - a. *Route Planning.* Movement with the grain of the country, rather than across it, is quicker, easier, less tiring for drivers and troops, less damaging to vehicles and uses less fuel. Often it will pay to make a detour along favourable going to avoid constant climbing in and out of wadis, negotiating ledges and escarpments, and grinding along in low gear through soft sand. Such a diversion may even be an advantage in deceiving the enemy as to one's ultimate objective.
 - b. *Cross-Country Speeds.* An appreciation of practicable speeds over various types of going is important in estimating the amount of time and fuel required for a journey. In bad going over rocky ledges and in soft sand progress may be as slow as 5 miles in the hour (8 kilometres in the hour), even in daylight. An average of 8 to 15 miles in the hour (12.8 to 24 kilometres in the hour) might be achieved by normal service vehicles crossing a mixture of softish sand studded with little bushes growing on small hummocks, stony ground and wadis,

2. A considerable amount of planning and preparation went into the passage of VIII (US) Corps formations, including 1 (BR) Armoured Division, through 1 (US) Infantry Division (Mechanized)'s Breach Zone NORMANDY in the Iraqi frontier border obstacle system.

although vehicles with hydropneumatic or hydrogas suspension systems are capable of cross-country speeds in excess of 30 mph (48 kph). Speeds of 60 miles per hour (96 kph) can be achieved on hard, firm, flat sand; the problem posed by sebkha (salt marsh) has already been mentioned in Part A Chapter 1. For planning purposes one should err on the side of caution and allow for mishaps. Out of contact speeds of 15 kilometres in the hour (8.5 miles in the hour) by day and 5 kilometres in the hour (3 miles in the hour) by night were the planning norm arrived at by trial and error for the Kuwait operation. In contact the speeds are reduced drastically to 2 kilometres in the hour (1.25 miles in the hour) and 1 kilometre in the hour (0.62 miles in the hour) by day and night respectively. When infantry have to move across really bad going, particularly on a cloudy, pitch-black night, it may be quicker to march than drive.

- c. *Planning Data.* For planning purposes, formation and battle group staffs should ascertain the average practicable speeds which can be attained over different types of going in daylight and at night in varying phases of the moon, in starlight or with no ambient light, with and without night driving aids. Of necessity, these rules of thumb speeds can only be arrived at empirically in a new theatre of war with the types of vehicle and night driving aids currently in service. If a period of grace is offered for training before committal to operations, staffs should make a point of using exercises to obtain and evaluate planning data rather than rely on the trial and error of battle.³

7. *Dispersion and Protection.*

- a. *Frontage.* With the need to keep at least 150 metres between vehicles to avoid presenting an attractive target to enemy aircraft, long range artillery and missiles, units out of contact with the enemy move on as wide a front as possible. Only when air supremacy is assured and the missile threat reduced may vehicles move closer together.⁴
- b. *Formation Reconnaissance.* The formation reconnaissance regiment should move as far ahead of the formation as possible consistent with the ability to obtain fire support. If close air support is available this may be as much as 30 to 50 km in advance. If not, it should not move out of artillery supporting range, as a rough guide about 20 km.
- c. *Battle Group Reconnaissance.* A battle group should deploy its reconnaissance elements on a broad front at least a long visual bound ahead of the main body so that the latter will be well out of range of hostile tank guns and anti-tank

3. Between the Second World War and the evacuation of the Canal Zone in 1956 British formations in Egypt planned on moving 20 miles (32 km) in 2 hours (1 hour 40 minutes driving and a 20 minute halt) by day and 10 miles (16 km) in 2 hours at night over reasonable going, out of contact. In the 1991 Kuwait campaign 1st (BR) Armoured Division used the Manoeuvre Speed Data obtained from experience on Exercises DIBDIBAH DRIVE and CHARGE: out of contact, 15 km in the hour by day and 5 by night; in contact, 2 km in the hour by day and 1 by night.

4. During Operation *Granby (Desert Sword)* vehicles in 7 Armoured Brigade could move at 50 metre intervals because the Allies had air supremacy.

missiles when the screen bumps the enemy. This is essential if the main body is to retain its freedom of manoeuvre. Because a threat may develop unexpectedly from any direction in mobile operations the flanks and rear must be watched as well.

- d. *Battle Group Formations.* The battle group will move in a formation appropriate to the tactical situation, usually with an armoured squadron group in the lead and with any artillery attached for movement tucked in behind the column, prepared to deploy into action off the line of march. If the country is open enough squadron/company groups may be deployed on either flank, perhaps two up in a 'square' battle group and one up in a smaller battle group. Guides are vital for the control of vehicle movement in battle groups and sub-units. See Annex D for some suggestions on desert formations. The anti-tank guided weapons will normally move on the exposed flank or at each corner of the formation if there is no specific threat. Similarly, the air defence detachments will be positioned where they can best provide protection.
- e. *Size of Battle Group Formations.* A battle group, less the screen, deployed in such a formation may cover a frontage of about 2,000 or more metres and a depth of over 3,000 metres. In less favourable terrain it may only be possible to move on a narrow frontage, making a battle group column 300 metres wide and over 5,000 metres deep. In the worst case, where movement is confined to a single track, or where the battle group has to negotiate a defile, the battle group will have to move in single file.
- f. *Standardization of Formations.* As far as possible the formations used in European terrain should be used or adapted where necessary to the desert. Units, which may be committed to action soon after arrival in a new theatre, will at least have the benefit of using familiar 'drills' and SOPs. Each vehicle must be allotted a specific place in whatever formation is adopted. Not only does this save time in forming up for a move but it ensures that everyone knows where commanders and the smallest sub-unit can be found in a hurry.
- g. *Planning.* From the planning point of view formation staffs must appreciate the effect of defiles on the passage of successive battle groups, first so that a formation move can be organized to avoid huge traffic jams and massive targets at bottlenecks, second so that a realistic appreciation can be made of the time required for a move and third to anticipate any engineer effort required to improve or maintain the route. Another aspect of planning concerns the need for staffs to appreciate how much more space units and formations need for dispersal in concentration, assembly and holding areas in the desert than in Europe.
- h. *Dust Hazard, Air and Mine Threats.* Small groups of vehicles should move in ragged echelon in such a manner that they avoid each other's dust clouds and offer the least attractive air target. If there is a mine threat there are advantages in moving in straight lines, vehicles travelling in the tracks of each line's lead vehicle, but beware the air threat.

8. ***Movement Control.***

- a. *Route Deployment Organization.* Control of movement is all important. It may be expedient to set up a permanent route deployment organization to create and maintain the MSR in the FCZ, particularly during a breaching operation and an advance. It will need equipment to clear mines, instruments to check for possible NBC contamination and plant to build a road.
- b. *Radio Control and Back-up Systems.* Operational moves are usually made on radio minimise, it being impracticable to move a large formation any distance on radio silence. Battle groups and smaller sub-unit sized groups may on occasions have to move under radio silence in which case control may be exercised using flag signals by day and lights by night. These signals also provide a reserve form of control for larger moves. See Annex B for details.
- c. *Route and Axis Marking*
 - (1) *By Day.* Battle group and formation axes are marked by long angle-iron pickets with the appropriate tactical signs displayed at the top. The height of the signs is important to make them easily visible from a driver's cab.
 - (2) *Night Signs, Homing Lights and Distance Markers.* Night signs are similar to those used in other theatres but more of them are needed because they stand on the ground and quite small slopes reduce the intervisibility distance. It is more important to site them on the top of rises in the ground than at strictly regular intervals. Formation provost and regimental police must check that the next sign, and preferably one or two more, can be seen from the one coming abeam of a vehicle in order to give the driver and vehicle commander confidence in the signing system, to indicate a line to steer on and to allow for signs which are knocked or blown down. A distinctive pattern of lights, visible over a wide arc to the rear, is necessary for homing battle groups on to the start point of a formation controlled route. Cyalumes are invaluable for marking routes in the dark for drivers using the naked eye. However, they white-out current night vision aids. A further refinement is the addition of distance markers, measured in kilometres from a selected datum point, to help units establish their position with accuracy and to assist in the direction of fire support.
- d. *Vehicle Lights.* For vehicles, conning lights, single red tail lights mounted high enough to be seen above the dust, or rearward facing red torches should be used to give drivers a steering mark and to prevent collisions. If night vision goggles are being worn, use green or blue lights at the upper end of the spectrum.
- e. *Traffic Control and Recovery.* Traffic control is essential at defiles, bottlenecks, on entering harbour areas and especially when passing one formation through another. Wheels and tracks quickly churn up the desert surface so that tracked and wheeled vehicle routes must be kept separate. Battle group LADs and unit

recovery vehicles should move at the rear of their columns to effect minor repairs or to tow non-runners. During a move on a really dark night it may only be feasible to recover breakdowns after first light.

9. **The Dust Danger.** Driving on a thin layer of soft sand on top of a firm surface raises such immense dust clouds that vehicles may have to move at 'dust distance' rather than the standard 150 metre spacing. It may be necessary to restrict the speed of movement on such favourable going to reduce the immense tell-tale cloud of dust, miles long, which may prejudice the security of a move. This precaution may even be necessary at night when a half to full moon makes dust visible from far away. In static conditions military police will sign stretches of routes where vehicle speeds must be reduced to avoid creating dust clouds which bring down enemy artillery fire.
10. **The Dust Opportunity.** Dust storms can be a help as well as a hindrance. They may hide a move round an unsuspecting enemy's flank. Modern navigational systems make accurate navigation possible in bad visibility. If the sand is blowing hard enough in the enemy's face the dust storm may make the enemy less vigilant and degrade his thermal imaging systems sufficiently to enable our forces to close on his position and achieve surprise. For such an operation vehicle tail lights should be switched on but sidelights blacked out.
11. **Identification of Key Officers.** One of the disadvantages of dispersion is the difficulty of finding commanders and key individuals. One way to overcome the problem is to fly distinctive pennants from their vehicle radio antennae, eg, two triangular blue pennants for the CO's command post, a blue and white pennant for a regimental or battalion headquarters, coloured pennants for squadron and company commanders, a black and white chequered flag for recovery vehicles and a red cross on a white background for the RAP. The pennants should be as small as possible, consistent with recognition within the battle group. Large pennants merely tell the enemy which vehicles to shoot at first. Even a small pennant can be readily identified with a pair of field glasses. Alternatively, a simple system of hessian 'rats' tails' may be devised,⁵ eg,

Commanding Officer	4
Second-in-Command, Squadron Leader, Company Commander	3
Squadron, Company Second-in-Command	2
Troop, Platoon Commander	1

A standard pennant (or alternative) system should be designed within a formation to avoid recognition problems on regrouping. Similarly, call signs painted on tanks, APCs/IFVs and other vehicles are useful for identification purposes but they should be toned down discreetly to avoid providing the enemy with good aiming marks. Once in contact it may be advisable to remove pennants and 'rats' tails' and rely on the painted call signs and the recognition marks mentioned in the next paragraph.

5. The 'rats' tail system was introduced by 7 Armoured Brigade during the DESERT SHIELD preparatory phase for DESERT STORM in 1990 and 1991 and the details have been taken from the Brigade's SOPs.

12. **Recognition.** Engagements between friendly forces and close air support attacks on one's own troops are a real danger in the confusion of mobile operations in featureless country, especially when both sides may use the same equipment. The following recognition aids may be useful:
- a. *Ground to Air.* Fluorescent panels, which can be displayed quickly, venetian blind panels on cab roofs which can be operated by a driver or vehicle commander and coloured smoke can all be used to warn friendly aircraft. The problem with coloured smoke is that it can be imitated by the enemy and changing the smoke colour code daily can lead to confusion.
 - b. *Painted Vehicle Symbols.* Permanent recognition signs can be used to identify friendly vehicles. The white star painted on the tops and sides of Allied vehicles in the latter years of World War II was superseded by the inverted V used by the coalition forces in the 1991 Kuwait campaign.
 - c. *Night Recognition.* The inverted V was made from materials which displayed a heat contrast with the vehicle surface so that it was readily identifiable at night through thermal imaging sights and viewers, eg, infra-red tape or polyester plastics. Similarly, silver foil call sign boards can be used to identify individual vehicles. A single coloured light fixed centrally and high up on the rear of each vehicle provides an easy method of identification at night to prevent the engagement of friendly troops, especially when formations are moving through each other, ie passage of lines.
 - d. *Boundaries.* Tight control of boundaries is essential. They must be clearly marked on maps, not crossed and never fired over. When it is necessary to change them, sufficient time must be allowed for dissemination. With satellite navigation systems the risks of units straying across boundaries is greatly reduced.
 - e. *Stopping Engagements between Friendly Forces.* Engagements between friendly ground forces can be stopped by IFF codes on the radio, light signals and passwords. As allied forces are likely to use different systems, standardization will be a high priority during the concentration phase in a new theatre of war. As prevention is better than cure, a system of positive clearance of air and artillery targets must be used to avoid damage and casualties to friendly forces, particularly allied ones.
 - f. *Alertness.* However, no system is foolproof. In the last resort accidents may only be avoided by alertness, quick apperception of a potentially dangerous situation and an appropriate rapid reaction.

SECTION 2 - DRIVING AND MOVEMENT

(See also RLC publication AC 70936/7 *Driver Training (All Arms)*) - Wheeled Vehicles Vol 1

Driver Training

13. **Soft Sand.** Drivers have to learn to recognize soft sand and avoid it whenever possible. If there is no way round drivers should shift into four-wheel drive, if not

already engaged, change down into low gear and keep going at a steady pace, taking care not to let the wheels spin. A driver should not follow in the tracks of the vehicle in front because his vehicle is more likely to get stuck. Turns should be made gradually to avoid building up resistance against the front wheels and bogging down. A sharp change of course may overturn a vehicle. Sudden starts and stops should be avoided to prevent wheel slip and becoming stuck in the sand. If a long stretch of soft sand must be traversed the tyre pressures should be reduced to increase the bearing surface and improve traction. On emerging from soft sand the tyres should be pumped up again to avoid damage and tyre bursts on rock and over-heating on roads. If the sand builds up between the rear sprockets and treads of tracked vehicles the driver will notice a lack of steering response. If ignored, the accumulating sand will eventually throw a track. The remedy is to go into reverse or to use the steering to shake the sand out.

14. **Unsticking a Bogged Down Vehicle.** Before a vehicle grinds to a halt the passengers should leap out and push. If the vehicle sticks, dig out the sand in front of all four (or more) tyres to form a gradual slope. Place sand channels, sand mats or PSP in front of and against the bottom of the tyres. Every passenger must be ready to push when the driver moves off again. Pushing should continue until the vehicle is well and truly mobile. The driver must maintain his 'revs' and keep going. A vehicle which is badly stuck may have to be winched out by another vehicle on nearby firm ground, care being taken to align the winch, hawser and bogged down vehicle to obtain a dead straight pull. The passengers from both vehicles must be moved well clear in case the wire hawser snaps and whips back. A vehicle bogged right down to the chassis may have to be extricated by a combination of digging, jacking up on PSP or planks and constructing a runway of sand channels. All these techniques have to be practised before taking to the field on operations. DROPS can recover itself in an emergency by deploying the flatrack and using the load handling system to push the vehicle forwards whilst applying drive to the transmission. However, this action does damage the hydraulics and gearbox. The CES for vehicles should include sand ladders and air bags which could rectify most problems.
15. **Sand Dunes.** The slopes of sand dunes are asymmetrical. The shallow slope faces the prevailing wind, the steeper slope is in its lee. The former usually has a crust enabling the wheels to grip the surface. The latter does not. If possible, dune fields should be traversed with the grain, along the valleys. If this is not possible there is a technique for crossing dunes motoring in the same direction as the prevailing wind. Drive up the shallow slope just fast enough to stop bogging down. On approaching the crest the vehicle commander and driver must make sure that there is a practicable exit or a shallow dune ahead before committing the vehicle over the crest. Ease the vehicle gently over the crest and steer straight down the steep slope. Apart from the risk of being trapped in a steep-sided bowl with no way out, driving fast over the crest is dangerous. The vehicle may somersault, killing or injuring the crew. Sand dunes and soft sand are best traversed early in the day before the sun burns off the night's dew and the brittle crust it forms. On encountering a dune field it is advisable to pull up short, dismount and examine the crest of the first dune to make sure that it is negotiable, and the reverse slope to ascertain that it is not too steep. The following dunes may follow the pattern of the first but, if there is any doubt, stop, get out and look.
16. **Rocky Ground.** A driver must pick his way carefully across boulder strewn ground. A large rock can break the sump, the steering or the transmission. Rocky ledges

should be taken diagonally so that only one front wheel crosses the shelf at a time. Apart from the vehicle damage caused by fast and careless driving, the comfort of the passengers must be considered. Good and bad drivers soon acquire an estimable or unenviable reputation.

17. **Tracks.** When they are firm, follow them. In soft going the bottom soon falls out of a track and the driver should use firmer ground parallel to it. Mix-in-place oiled tracks become dangerously slippery after rain. Tracks on hard sand tend to become corrugated, the corrugated ripples running across the track from one edge to the other. By trial and error drivers will arrive at the optimum speed which causes the minimum of vibration. Driving too fast or too slowly is boneshaking for the passengers and damaging to the vehicle and the equipment it carries. When using a narrow hard surface track across soft sand be careful when passing another vehicle. Slow right down and ease the nearside wheels off the track gently. If the driver goes too fast his nearside wheels will be retarded violently by the soft sand and the vehicle will overturn. Finally, if one does not know where a track leads, do not follow it blindly but use the same navigational aids and methods as one would employ in the open desert.
18. **The Vehicle Commander's Responsibility.** The driver is too busy picking a route, steering and changing gear to navigate, except to maintain a fixed bearing on a sun compass in flat, open desert. The vehicle commander must be responsible for navigation and map reading. He should also see to it that the driver gets all the help he needs from the passengers for camouflaging, replenishment, and maintenance at halts. At night he must not only help the driver to steer and navigate but must make sure that he stays awake. Vehicle commanders must never doze off.
19. **Halts.** At halts, ideally, the vehicle should be turned into wind and the engine idled fast before switching off. For security reasons it may be necessary to halt at the end of a navigational leg and to face the vehicles in different directions so as not to give enemy air, satellite or RPV reconnaissance a clue as to the direction of the next move. Halts will be used for refuelling, running repairs, feeding and, when necessary, giving out orders. Five minutes before moving off vehicle crews must ensure that all equipment and stores are properly secured.

Movement

20. As previously mentioned, battle groups and formations will move on as broad a front and as widely dispersed as possible. Vehicles should be staggered so as to deny enemy aircraft a lucrative series of targets in a straight line. The worse the dust problem the greater must be the distance between vehicles.
21. Whether movement is controlled by radio or flag, bat or light signals will depend on the need for radio silence. Flag and light signals may be seen in Annex B. If flags, bats or light signals are to be used there is an advantage in having a standard system in that it will not be necessary for units or sub-units to learn a new system on regrouping.

BASIC DESERT NAVIGATION AND MAPPING

Navigation Systems

1. **Satellite Navigation Systems.** With modern satellite navigational systems (SATNAV) it is easy to fix one's position quickly and accurately. The systems currently in use are:
 - a. *Transit System.* A US system which will remain operational until the year 2000. Navigation receivers can fix a position to either 0.02 of a nautical mile, or 40 metres. The system will be superseded by:
 - b. *Global Positioning System.* Completed, in early 1994, it consists of 21 working satellites, plus three reserves, to ensure that four Navstar satellites are above the observer at any one time and place. With a commercial receiver the user will be able to fix his position to either plus or minus (\pm) 100 metres in plan and height. Military receivers incorporating an appropriate decoding unit will provide a positional accuracy of ± 15 metres. The simple hand held GPS receiver weighs less than a kilogram.
2. **Sun Compasses.** Sun compasses are primarily for use mounted, although one type is also suitable for use on foot. The instrument can be bolted to a B vehicle through a small hole drilled in the top of the bonnet or fixed to a bracket in front of the user or clamped to the hatch of an A vehicle. For steering a course a sun compass is far more efficient and easier to use than a magnetic compass. A sun compass indicates true north.
 - a. *Types.* There are two types, named after their inventors:
 - (1) *Prain-Starbuck's.* A development of the Howard's Mark II which can be used mounted or on foot. It works in high latitudes where magnetic compasses become unreliable because of unpredictable fluctuations in the horizontal component of the earth's magnetic field near the poles. The shadow angle disc must be changed fortnightly to allow for alterations in the sun's azimuth (bearing) from the observer and height above the horizon for any given latitude throughout the year. The shadow angles can be drawn on a blank plastic disc from shadow angle tables. However, for a future campaign ready printed discs will be prepared by Military Survey if this instrument is to be employed.¹ This sun compass can only be used by day.
 - (2) *Cole's.* A vehicle mounted instrument only but one which can also be used at night by sighting it on the Pole Star in the Northern Hemisphere and the

1. Ready printed shadow angle discs were prepared by the School of Military Survey for Operation GRANBY.

Celestial Pole in the Southern. Although more expensive and slightly more complicated to set up, no shadow angle disc and tables are required. All the information to work the instrument is contained on the circular bearing plate.

b. *Additional Uses.* Both instruments may be used to:

- (1) Determine the bearing on which the vehicle is pointing.
- (2) Take a bearing on a distant object.
- (3) Determine local sun time.

3. ***Theodolite.*** With some basic knowledge of astronomy a trained observer can determine his position by making timed measurements to the sun or stars.

4. ***Training.***

a. The School of Military Survey, 42 Engineer Group, Hermitage, near Newbury, provides the following services:

- (1) Training for unit map reading instructors.
- (2) Navigation training for those in reconnaissance appointments or about to join expeditions.
- (3) Training in the use of satellite navigational receivers.
- (4) General advice on map reading and land navigation.
- (5) Sponsorship of the Manual of Map Reading and Land Navigation (Army Code 70947).

b. Navigation training is normally carried out in theatre or before moving to a new theatre under formation arrangements. Additional specialist support may be provided by military survey units.

Other Navigational Aids

5. Simple aids for keeping direction or determining one's position include:

- a. Tracer fired by a GPMG on a fixed bearing may be used to keep direction during a 'noisy' attack, particularly at night.
- b. Artillery and mortar concentrations fired as part of a timed programme can provide local landmarks and a useful time check. However, an unscheduled 'repeat' may confuse someone who places too much faith in timings. Similarly, coloured smoke and illumination rounds can be used to provide reference points.

- c. A tank gun stabilizer, which uses a gyroscope, can be used to maintain direction out of contact.
 - d. Radars can be used to obtain the bearing and distance of a vehicle in open country.
 - e. A directional aerial can be used to obtain a rough fix from two or more transmitters (including civil broadcasting stations) or beacons.
 - f. Homing beacons and radar for aircraft.
6. Active aids should be used with discretion because they may give away intentions and be vulnerable to counter-measures. If the same aid is used in the same way repeatedly the enemy may jam, destroy or spoof it. While such aids are useful they should not be depended upon. Units must make their own navigational arrangements.

Mapping

7. The quality of survey in the desert varies from very good to very bad depending on the need for accurate survey in peacetime. If the area contains valuable oilfields it may be well surveyed. Sensitive frontiers may also be well mapped but the survey may not be made available by the government of the territory for security reasons. In the worst case only small scale, inaccurate maps will be available and a force sent to the area must be prepared for a major air and ground survey effort.² Some battlefield information systems will require up to date digital terrain data.

Going Maps/Terrain Analysis

8. Going maps for vehicular movement are usually prepared under force or theatre arrangements using Royal Engineer survey units and air and satellite reconnaissance. They take time to produce and are usually classified and given sufficient security protection to avoid useful information falling into enemy hands.
9. Because survey resources are likely to be overstretched, particularly at the beginning of a campaign, the force headquarters may divide the operational area up into sectors and allot them to formations and units to carry out going reconnaissances. Special long range reconnaissance forces are likely to be tasked with the survey of deep, exposed flanks and areas behind the enemy's lines with the aim of ascertaining axes which pose a threat to us or which we may use to outflank him. Reconnaissance beyond the enemy's lines is necessary to provide information on which future offensive plans may be based. Long range ground and photographic air reconnaissance must be carefully coordinated and conducted in such a way as not to prejudice the security of future plans.

2. Advice on mapping and geographic information should be obtained from the geographic staff at higher formation headquarters.

10. While areas closer to the FEBA are likely to be allotted to armoured reconnaissance regiments, any combat or supporting arm unit must be capable of carrying out a going reconnaissance. Force headquarters must disseminate a common terminology to describe the various types of going which may be encountered together with a common colour scheme to illustrate them:
 - a. *Good*. Firm and fast; unrestricted movement at all times.
 - b. *Fair*. Passable at all times in dry weather but free movement may be hindered locally by patches of soft sand or rocks. Difficult or impassable in places when wet. Patches of sebkha subject to flooding should be marked.
 - c. *Poor*. Passable with difficulty in low gear. When wet either impassable or motorable only with great difficulty. Prior reconnaissance essential to pick routes.
 - d. *Bad*. Impassable at all times.
11. Going relates primarily to 4 wheel drive 4 ton vehicles unless otherwise stated on the basis that where wheels can go tracks can move even more easily. While going reports describe the suitability of ground for wheels and tracks in detail, going maps are, or should, be annotated to indicate significant obstacles to both wheels and tracks. Standard conventional symbols should be promulgated to mark obstacles, such as escarpments and sebkha (if not adequately marked on current survey), good viewpoints, hull down tank positions with optimum fields of fire and to indicate the most favourable direction of cross-country mobility (CCM) with the grain of the country over broken ground. Going maps and normal survey should include a reliability diagram to assist staffs in planning and to direct the reconnaissance effort where it is most needed.

Panoramas

12. A panorama is invaluable for relating the map to the ground when reporting enemy movement, locating DF and FPF tasks and for briefing visiting commanders and relieving units. It gives a visitor or a relief a sense of scale as well as a ready reference to important features.
13. As many features are unnamed, and often unmarked, nicknames are useful. If they are to be used to report enemy movement be sure to inform battle group or brigade headquarters of their identity and grid reference in advance. It is more necessary to exaggerate the vertical scale in the desert than in European terrain in order to make features recognizable. If time permits, unit intelligence sections should prepare duplicates of panoramas for use in their battle group headquarters. In featureless country the location of enemy activity can be reported by the OP using the horizontal and vertical scales as a reference, provided the headquarters has a copy of the panorama.
14. The pattern of light and shade and the amount of detail seen from an OP changes considerably with the movement of the sun across the sky. Features which are hidden

by shadow or glare in the morning become readily visible in the afternoon and vice versa. If time allows, a panorama should be worked on throughout the day. If not, the direction of the sun should be indicated in the margin. Do not forget to allow for magnetic variation. Failure to do so may result in gross errors because the field of view is so long in the desert.

FLAG AND LIGHT SIGNALS

Uses and Control

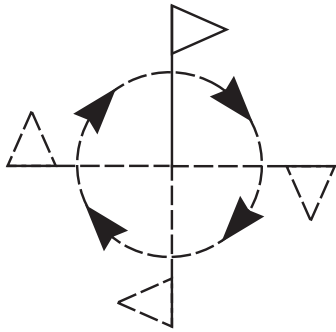
1. When it is necessary for small columns of vehicles to move in radio silence flag and light signals are useful to control movement by day and by night.
2. The column guide or navigator can be stationed 100 metres ahead of the leading vehicles where his signals can readily be seen. If the column is a large one it may be necessary to sub-divide it and appoint a movement controller for each group. To ensure that the signals are seen throughout the column each group of vehicles appoints a movement controller who travels in the group commander's vehicle. The latter repeats the signals initiated by the battle group navigator or from the movement controller of the group of vehicles in front of him if he cannot see the former.
3. The battle group navigator raises his flag(s) to initiate a signal and checks that the squadron/company group and other sub-unit group movement controllers have repeated it. The drop of the flag(s) is the executive order.
4. The flags may be of any colour which contrasts with desert and sky and can be seen easily. The flag signals may be seen at Appendix 1 to this Annex.

Night Lamp Signals

5. Either hand hold or fasten a blue or green¹ lamp on the navigator's vehicle facing backwards at a height which can readily be seen by at least the leading groups in the column. Each combat team or sub-unit group's movement controller will have a similar lamp to repeat the navigator's signals.
6. Prepare to move - Lamp switched on and off for half a minute and finally off.
7. Move or advance - Switch lamp on. During the move the navigator and sub-unit movement controllers' lamps are kept on both as a signal to continue moving as well as to act as a driving mark for the groups behind.
8. Halt - Lamp switched on and off for half a minute and finally off.

1. If NVG are in use blue and green are more covert than red lights, which stand out at a considerable distance.

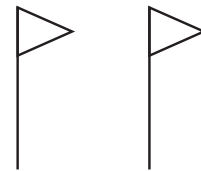
FLAG SIGNALS



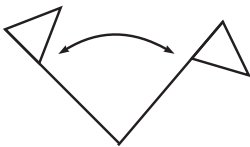
1. Start and embus.
Circular 'starting up' signal in a vertical plane. Alternately, the signal can be given by the hand alone.



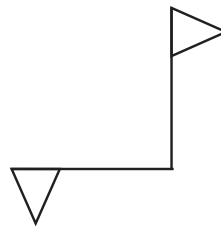
2. Move off or advance.



3. Halt.



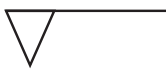
4. Open formation. One flag waved from left to right repeatedly, as for the 'extend' signal.



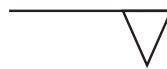
5. Column (three vehicles abreast)



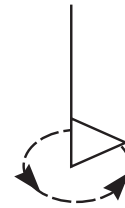
6. Single File.



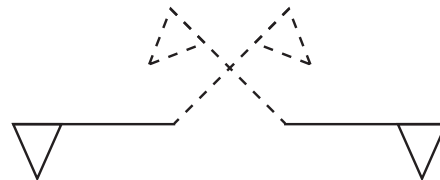
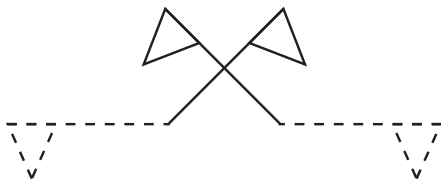
11. Wheel left.



12. Wheel right.



13. Brew up. Stirring motion with an inverted flag.



14. Open out.
Cross and uncross flags finishing with flags uncrossed. To close in further use the same signal finishing with crossed flags.

CHAPTER 3

OPERATING IN THE DESERT

SECTION 1 - DESERT ROUTINE

The Daily Round

1. In a strange and taxing environment it is useful to follow a set routine to make sure that nothing of importance which may affect operations or administration is overlooked. Although it is wise to enter a caveat against laying down any hard and fast procedures in advance of deployment to a new theatre there are certain sound rules to remember. If they are not observed there must be a good reason.
2. In defence the day starts half an hour before sunrise. Within the formation everyone stands to, whether in defensive positions, headquarters or logistic units. Stand-to gives an opportunity to check weapons, ammunition, equipment, the manning of local defences, observation areas and to discover whether enemy patrols have probed the position during the night. Reports are collected from sub-units, sifted and passed to higher headquarters. Everyone wants to know what happened during the night and what the assessment of the situation is at daybreak because events move fast in the desert.
3. In rear areas when the enemy air, missile and artillery threat is so low that it can safely be ignored it may be convenient from the administrative point of view for units and headquarters to move into close leaguer or harbour, 10 yards between vehicles. Depending on the threat it may be possible to remain in close order 24 hours a day, or it may be advisable to spread out into open order at dawn. In these circumstances there should be a drill for moving into open formation at first light and camouflaging up. Sufficient space should be left between units in close leaguer so that they can extend into open order without colliding with each other. If replenishment is to be carried out in close leaguer a strict traffic pattern must be established so that wheeled vehicles can be routed clear of the soft sand churned up by tank and IFV tracks. An alternative is to adapt the north-west European hide system in which sub-units disperse into troop or platoon groups in which the vehicles halt in a standard formation with which everyone is familiar.
4. If contact has been lost with the enemy screen during the night contact has to be re-established as soon as possible. This is essential to guard against surprise, to detect a secret withdrawal or any other change in the enemy's dispositions which may provide indicators as to his intentions.
5. The day may be boring but vehicle camouflage must be checked and rearranged as the sun's shadow varies in angle and direction. Every opportunity has to be taken during quiet days to carry out repairs to vehicles, weapons and equipment.
6. The dangerous times are when the sun is behind the enemy and in our eyes, during the midday shimmer when enemy moves may pass unnoticed and in sandstorms which are not severe enough to stop all movement. Extra vigilance is required to

prevent surprise. Additional OPs and armoured reconnaissance patrols may be necessary to cover vulnerable sectors during bad visibility. The surveillance and target acquisition plan must take into account all weather and terrain factors which affect observation.

7. From the control and administrative points of view there are great advantages in adopting standard vehicle formations which can be used for movement and at the halt. It is easier to find people in the dark, to hold order groups and briefings, and to organize resupply and repair. Advances in night observation devices, ground and airborne radar and other sensors make it so easy for the enemy to detect tight concentrations and to bring down artillery, guided weapon or air attacks on them that close leaguering in the operational area is no longer feasible. In the battle area, forming close leaguer may not merely be dangerous but may surrender a tactical advantage to the enemy. With the night sights now in service replenishment in open formation is no longer a problem.
8. On a routine move when a battle group can afford to halt for the night, defensive positions are selected at sunset and arcs of fire are allotted according to an established drill. Anti-tank weapons will be positioned at the corners of a formation and GPMGs will be sited to form a pattern of crossfire to cover its front, flanks and rear. Listening posts and surveillance devices will be deployed and allotted arcs of responsibility. Any dominating feature close by will be occupied and mortars will be laid on likely approaches if there is any danger at all of enemy attack. Similarly, any air defence weapons attached to the battle group will be deployed. Normally, troops should sleep behind their vehicles, instead of beside them as in Europe, to leave clear passages up and down the rows between IFVs, trucks and tanks, with lateral gaps at intervals, to allow for the passage of liaison officers, the assembly of 'O' groups and replenishment. The reason for sleeping between the front and rear of vehicles is that an open formation is much greater in depth than in width and the arrangement makes for quick passage longitudinally. If, however, camouflage nets are left up at night troops may sleep anywhere underneath them but sentries must be prepared to warn off approaching vehicles. As far as possible, battle group, squadron or company group and troop or platoon command vehicles are located in the same column or file of vehicles for ease of location in the dark. As orders for the next day will often be given out after dark it is important to mark unit and sub-unit headquarters discreetly in order that key people can be found easily. Everyone must know where his immediate commander and his superior are located. On moonless nights tape will be needed to mark routes to command posts and other key areas.
9. Apart from the discreet marking of headquarters and key facilities no lights will be shown at night nor will there be any movement except for the essential operational or administrative reasons mentioned in the last paragraph. LADs and workshops must be allowed to use lights and make a noise at night. They should be allocated an area at a discreet distance from the units they serve. If a person has to move away from his position or vehicle on a pitch black night for any reason he must tie a length of string to his base and pay it out as he goes. Failure to do so is likely to lead to a sleepless night trying to find one's position, disturbing other people's rest in the process. Anything which the dew is likely to spoil should be covered up.

10. Evening stand-to is a convenient time for briefing to keep everyone in the picture. A note should be made of local landmarks and the points of the compass in case it is necessary to move in an emergency during the night. Should the battle group be shelled there must be a drill for packing up and moving off rapidly up to a mile away. An alternative hide or harbour site should be selected off the map and pointed out to commanders and the drivers of the leading vehicle group before dark.
11. Shortage of water makes discipline in its use essential. The order of priority for the individual is drinking and then, 'To brush teeth, shave and wash in that order with even as little as a cup of water, and do so at least once a day.' Do not accept hordes of flies as inevitable. The pest can be controlled.
12. Uncontrolled open fires should not be permitted when they may be detected by enemy patrols, observation or sensors. By night flames can be seen from great distances and by day smoke betrays positions. Refuse should either be buried or burned at night in carefully controlled and screened fires because smouldering garbage gives off clouds of smoke. Whenever possible, cooking should be carried out in daylight. Not only does the glow from burners give away one's position but on a dark night cooking and feeding without showing lights is very difficult. Although dispersion will often dictate cooking on a vehicle basis it should be centralized whenever possible to make the most of the rations.
13. When the opposing sides are well matched a battle may go on for a long time at a high tempo. Troops, and especially commanders, must get as much sleep as possible so that they go into battle, which may last for weeks rather than days, as fresh as possible. Now that satellite navigation and night vision aids enable armies to conduct intensive operations around the clock fatigue is going to wear down the endurance of troops in all environments but especially in a mobile battle in the open desert where there is little cover and few obstacles behind which an exhausted formation can find some protection and respite. It will be necessary to plan operations so that formations are rested periodically. The system of committing manoeuvre groups sequentially, supported by all the fire support available, and then grounding them for replenishment and reconstitution used by 1st Armoured Division in the Kuwait Campaign of 1991 lends itself to providing at least some sleep for tired troops. As many soldiers as possible should be taught to drive so that reliefs can take over in prolonged operations. Many a vehicle and crew have been lost dropping over an escarpment or overturning because the driver and vehicle commander have both fallen asleep. Every opportunity must be taken to catnap between moving, fighting, maintaining equipment and eating. Under the stress of battle men become exhausted in a hot and hostile environment quicker than in a temperate climate. Much modern equipment requires careful, periodic checking and maintenance. There will be a temptation for tired troops to skip essential maintenance and officers and NCOs must see to it that essential checks and servicing are carried out.
14. Be tolerant and helpful to newcomers. Veterans should avoid the temptation to inflate their egos by making life in the desert seem more difficult than it really is. Accept new arrivals into the team. The small group, the tank crew, the armoured infantry section, the weapon team and the gun detachment, are especially important as the foci of loyalty and the mainstay of morale in the dispersed living which is such a feature of

desert warfare. New arrivals have to be taught the 'buddy system' to make sure that everyone brushes his teeth, washes, shaves, feeds, rests or stays alert and that symptoms of illness or battle fatigue are noticed early. The aim is to make the reinforcement welcome, integrate him into the team and turn him into a desertworthy soldier as quickly as possible. The Desert Code, an old soldiers' guide to the desert, is given in Annex A.

15. Finally, do not forget the day and the date. While this may sound trivial, indifference is the first sign of a slide into mental apathy, and, possibly, a fatal lack of alertness.

SECTION 2 - CAMOUFLAGE AND CONCEALMENT

The Importance of Camouflage Training

16. **Relevance.** Camouflage is an essential part of all operations in the desert and the importance of the subject must be impressed on fresh units and individual reinforcements as soon as they arrive in a desert theatre. Failure to convince new arrivals of its importance will lead to unnecessary casualties and a shortage of the essentials of life when a crew's vehicle is destroyed, even though they may survive. Bad camouflage may also compromise a high-level plan and lead to an operational failure with all its attendant casualties. One poorly concealed vehicle is enough to alert enemy intelligence to institute a thorough search, revealing a battle group or an entire formation. Successful concealment, camouflage and deception is as much a matter of knowing how to use existing concealment kits as well as being able to improvise with whatever comes to hand.
17. **Supervision.** Vehicle commanders and drivers must ensure that their vehicles are camouflaged whenever a halt is to last more than ten minutes. Officers and NCOs have a special responsibility for checking the effectiveness of their sub-units' camouflage. If stationary for several hours they must make periodic checks to make sure that the changing pattern of shadows caused by the movement of the sun is matched by adjustments to the way nets, concealment sets and hessian are draped.

Vehicle and Aircraft Camouflage

18. **Desertization of Vehicles.** The subject is covered in Annex B. The important aspects to note here are that windscreens and windows should be removed or wound down to prevent reflection of the sun and that, in the forward area, vehicle silhouettes should be reduced by removing unnecessary cabs and canopies. However, items removed must be kept handy so that they can be refitted in cold, wet winter weather and during the sandstorm season to protect crews, kit and equipment.
19. **Paint.** Tracked and wheeled vehicles, towed equipment and helicopters should be suitably painted. A matt stone colour is suitable for many deserts. Other colours may be required to tone in with other desert environments. In bush covered desert even the standard dark green and disruptive paints used in central Europe give some camouflage if it is not possible to repaint the vehicles of a unit despatched in an emergency. One of the duties of the initial reconnaissance party sent to a new theatre

is to select the colour and camouflage patterns most suitable to the area and signal the information home so that an early start can be made on painting vehicles.¹

20. **Concealment Sets.** These sets, which include their own framework support system, are ideal because the thermal camouflage material offers good concealment from the human eye, near to the infra-red end of the spectrum, reduces the thermal signature and defeats radar. Until special desert sets are made the moorland net designed for the southern flank of NATO will be better than nothing. On a very hot day concealment sets may betray the equipment they are designed to hide by giving a cooler return to an enemy sensor than the surrounding sand, gravel or rock.
21. **Improvised Camouflage.** This paragraph deals with the occasions when it is appropriate. Hessian which bleaches to a sand colour in the sun, stretched on nets and poles just sufficiently high above a vehicle to allow air to circulate between the two will provide effective visual camouflage, shade and a welcome drop in temperature. Additional hessian or a canopy laid on the vehicle metal surfaces will help to reduce the thermal signature because metal heats faster than sand, gravel or rock in the sun. Camouflage should be built in a shallow dome over a vehicle, with angles of no more than 15° or 20° from the horizontal, to avoid tell-tale shadows. If only camouflage nets and scrim are available, hessian must be hung to hide the shadows caused by track suspensions and the space between the chassis and the ground. Nets and hessian must be arranged so that they do not form pyramids over upright poles and straight edges along horizontal rails. Inflammable material must be kept clear of radio antennae and exhausts. The latter should be screened if possible to reduce the heat emission which can be picked up by sensors. In certain circumstances it may be useful to improvise a method of camouflaging the turret of a tank, or other armoured vehicles, separately from the chassis so that the turret can be rotated and the gun brought into action in an emergency. Everything to make improvised camouflage must be brought up from base: poles, sticks, angle-iron pickets or pins, mallets for knocking them into the ground, ropes for securing hessian and nets in high wind and machetes for cutting natural camouflage from bushes. More material is needed than in a central European scene and the camouflage kit must be as much a part of the vehicle as its essential spares. Should the course of operations take the force into a desert with a markedly different coloured surface, spray guns are useful for applying the appropriate paint.
22. **Helicopters.** Some helicopter blades may be damaged by hanging hessian over them. Others can stand the weight and, in the case of a four-bladed propellor the blades should be moved to make an angle of 45° over the fuselage, in the pattern of an 'X'. With the help of some additional poles and pickets, camouflage nets and hessian can be draped in a dome over the helicopter to disguise its shape. All perspex surfaces must be covered with material to prevent reflection from the sun.
23. **Bowsers.** Because water and fuel bowsers are high value targets they should be disguised with canopies to look like load-carrying vehicles, at least in rear areas.

1. 'SAS pink' was produced with the Libyan desert in mind.

Concealment of Headquarters and Installations

24. **Track Discipline.** Some types of ground, such as pebbles, clay and a thin layer of sand on rock, show up tyre and track marks very clearly. Whenever possible, these surfaces should be avoided for headquarters, comcens and gun positions. CSS installations and headquarters should be located near well defined tracks, not merely for convenience, but to avoid leaving tell-tale tracks which appear to end abruptly but which pinpoint otherwise well camouflaged key links in the command and supply chain to the enemy photographic interpreter. When an area has been fought over several times there are so many tracks and so much battle wreckage that concealment becomes much easier. If it is not necessary to move widely dispersed on a broad front, confining vehicle movement to signed tracks helps to conceal the amount of movement. Occasionally it is possible to erase tracks leading to an important vehicle or site from a well established and recognizable route.
25. **Reducing a Headquarters' Signature.** Headquarters are too readily recognizable. To make them less conspicuous, site helicopter landing zones (LZs) and visitors' car parks well away from the command element and remote aerals, preferably to broken ground, or a wadi with bushes, to absorb the shadows. Helicopters approaching a headquarters LZ should use terrain cover and, if possible, alight on and take off from membranes to reduce the dust signature. In the absence of membranes, oil poured on the ground stabilizes the sand but leaves a prominent dark stain.
26. **CSS Installations.** Dumped combat supplies should be spread out in low stacks in irregular patterns and camouflaged. If possible they should be dug in. In case a dump is located by enemy reconnaissance or surveillance not all the stocks of one commodity should be kept in one place.

Concealment and Protection of Positions

27. **Positions.** A trench leaves an unmistakable, sharply etched, black scar in the ground, caused by sun and shadow. It is instantly recognizable to hostile pilots and photographic interpreters. Positions should be covered with hessian or camouflage, even if they do not have shelters. Shelter entrances must have hessian draped over them to conceal the shadows. If overhead cover is rigged to provide shade in the hot season as well as concealment it must be graded into the surrounding ground so that it does not reveal a sharp silhouette to betray the position. Loopholes must be shaded with camouflage nets or hessian to hide their shadows. Depending on the circumstances, it may be necessary to remove the overhead cover from weapon positions once an engagement has started to give riflemen and weapon teams more freedom of action and to prevent the material from catching fire over the heads of the occupants. Blending positions with overhead protection into their surroundings is not easy in the open desert, hence the advantage of siting infantry positions in broken ground where the defences can be hidden more easily. In the absence of low gebel and escarpments, wadi beds, where digging is easy and which provide some vegetation cover, make good defensible positions, except in the short wet season. In gently rolling desert wide wadis provide cover over a large area. They also offer good reverse slope positions.

28. **Vehicles.** If a vehicle is to remain in a position in the forward area for several days it must be dug in and camouflaged.
29. **Air Defence Radars and Weapons.** Because radar scanners rotate and air defence missiles have to be at instant readiness to fire it is virtually impossible to conceal them, although radar-transparent material can be used to conceal the former from visual and photographic reconnaissance. All associated vehicles and equipment should be dug in and camouflaged.
30. **Generators.** Generators are not only vulnerable but make so much noise that they should be dug in. Sufficient air space should be allowed round the generator to enable heat to escape. It may be possible to erect a thermal screen well above it to reduce the heat signature, provided that it can be concealed from direct enemy observation.

Deception

31. **Dummies.** Troops must be trained in the correct way to erect dummy equipment so that it not only presents a realistic outline in a plausible location but also gives the correct thermal signature and radar return. Landrovers or, better still, tank dummies on truck chassis towing chains, can simulate armoured movement. Another device is the large, collapsible photo board of current equipment to simulate tanks and IFVs.
32. **Deception Training.** Troops should be trained to prepare dummy positions which are good enough to fool the enemy but which would be of no use to him if he were to seek cover in them during a mobile battle. While individual enterprise should be encouraged in local deception to draw enemy fire, elaborate schemes should be checked out with higher headquarters in case they should jeopardise the success of a real plan. Although the British Army has no psyops capability some potential allies do and may provide psyops detachments.

THE DESERT CODE

1. Your chief concern is not to endanger your comrade.
2. Because of the risk you may bring him, you do not light fires after sunset.
3. You do not use his slit trench at any time.
4. Neither do you park your vehicle near the hole in the ground in which he lives.
5. You do not borrow from him, and particularly you do not borrow those precious fluids, water and fuel.
6. You do not give him compass bearings which you have not tested and of which you are not sure.
7. You do not leave any mess behind that will breed flies.
8. You do not ask him to convey your messages, your gear or yourself unless it is his job to do so.
9. You do not drink deeply of any man's bottles, for they may not be replenished. You make sure that he has many before you take his cigarette.
10. You do not ask information beyond your job, for idle talk kills men.
11. You do not grouse unduly, except concerning the folly of your own commanders. This is allowable. You criticise no other man's commanders.
12. Of those things which you do do, the first is to be hospitable and the second is to be courteous. The day is long in the desert and there is time to be helpful to those who share your adventure. A cup of tea, therefore, is proffered to all comers - it is your handshake and your badge of association. Over the tea mugs the good-mannered guest transacts his business expeditiously, gossips shop for a little, and gets him gone.
13. This code is the sum of fellowship in the desert. It knows no rank nor any exception.

DESERTIZATION OF VEHICLES AND MINE PRECAUTIONS

Vehicle Modification

1. *Adaption of Vehicles to the Desert.*

a. *Modifications.*

- (1) In the forward area, windows should be wound down and windscreens removed when there is a danger of the sun's rays being reflected towards the enemy. Alternatively they may be screened with suitable material or, in an emergency, covered with a mixture of sand and oil. In cold, wet winters the glass may be replaced provided that precautions are taken to prevent the sun's reflection. External mirrors should be covered or removed except when it is safe or essential to use them, eg, on roads.
- (2) Remove canopies and canopy bars from all personnel carrying vehicles which may be exposed to surveillance from enemy positions, both to reduce the silhouette and to enable passengers to dismount quickly in the event of an unexpected engagement or air attack.¹ The canopy should have a prominent white cross painted on the under-side (width of each arm to be 3 feet or 1 metre) and stowed ready for display if the occupants become lost.
- (3) If canopies are left on, either to give passengers protection from the sun in extreme heat or for convenience in rear areas, the sides should be rolled up for ease of debussing quickly in the face of an air attack and for the coolness and comfort of the passengers. The rear end of the canopy should be fastened down to prevent the suction of sand into the back of the vehicle.
- (4) Fix brackets to carry extra water (one jerrycan per six men) and fuel (a minimum of 50 miles spare fuel). Any vehicle which is to be used deep in the desert should carry the kit for making a water still. See Annex B to Chapter 1.
- (5) Hole bored, or bracket attachment, to mount a sun compass on navigators' vehicles if this is still considered necessary as a precaution against the failure of GPS receivers.
- (6) Cover headlights, sidelights, brake lights and reflector glass. Brake lights should be disconnected. Convoy lights may be retained for use when it is safe to do so. If night vision goggles (NVG) are used, rear red lights should be taped over.
- (7) Some armoured vehicles may need internal cooling systems for crew comfort.

- b. *NBC Modifications.* When there is a NBC threat the following additional measures must be taken:
 - (1) Check and make good any internal insulation, particularly on air-conditioning ducts.
 - (2) Check that all duct and fan (punka) louvres are clear and working. If possible, measure the air flows from each louvre.
 - (3) Check and repair any leaks in the air-conditioning ducts.
 - (4) Clean air-conditioning heat exchange elements wherever they are accessible.
 - (5) Check all door seals around the crew compartments and renew as required.

- c. *Desirable Modifications.* None of the following may be available initially but should be provided as soon as possible.
 - (1) Balloon sand tyres to reduce the ground pressure, enabling a vehicle to traverse soft sand more easily.
 - (2) Sand filters.
 - (3) Winches on a scale of one vehicle per combat team, squadron or company, in addition to unit LAD vehicles.

- 2. ***Vehicles Operating Far From Base.*** Vehicles which are required for operations over extended distances and times have to be large enough to carry the fuel, rations and water required. Even so, such vehicles are considerably overloaded and extra leaves must be fitted to their springs. To conserve water in the cooling system, which would otherwise boil off as steam, condenser cans and hoses must be fitted to radiators. Tubes or pintle-mountings should be fitted to enable machine-guns to be used in an anti-aircraft role. Long range patrols must carry a special scale of spare parts.

Vehicle Equipment

- 3. All vehicles must carry:
 - a. Complete tool kit, including a jack and wheel brace.
 - b. Shovel.
 - c. Pick.
 - d. Camouflage net.
 - e. Hessian screen to go over the camouflage.

- f. Sufficient poles to construct a framework for the camouflage net and hessian to avoid casting shadows.
 - g. Pegs to anchor the outside edges of the camouflage net and hessian screen.
 - h. Tow chain, to be permanently fixed to the front of the vehicle to facilitate recovery or quick extraction from soft sand.
 - i. Spare wheel.
 - j. Fuel and water jerrycans on the scale mentioned in paragraph 1 a (3) above.
 - k. Two air recognition panels.
 - l. White flag, 4 feet by 4 feet on a pole for planting on the nearest high ground to attract attention if lost.
 - m. Canopy or hessian painted as per paragraph 1 a (2) above.
 - n. 20 feet of white tape, 12 inches wide, for making ground to air signals.
 - o. Sand channels and/or sand mats. Lengths of PSP are a useful substitute.
 - p. Two days' spare rations per man. Small parties should carry a minimum of 6 days' rations and water.
 - q. Matches for lighting signal fires.
 - r. Smoke grenades for attracting attention.
 - s. First aid kit.
4. All vehicle commanders must carry:
- a. Map.
 - b. Compass.
 - c. Protractor.
 - d. Verrey pistol.
 - e. Binoculars.

Mine Precautions

5. ***The Threat.*** In counter-revolutionary operations there may be a serious mining threat. On tarmac roads the main threat will be from command detonated bombs hidden in culverts, although insurgents may excavate a cavity under the hard top if the

roads are not used, patrolled or watched at night. Other dangerous places are where sand tracks join a surfaced road. In the open desert enemy raiding forces or insurgents may bury mines under well-used sand tracks, running a loose tyre over the surface to camouflage them. The risk is especially dangerous in defiles, where tracks converge to cross wadi beds, or in passes through gebel.

6. **Security.** When there is a mining threat roads and routes in constant use should be patrolled, watched with night observation devices and searched regularly. Those not in constant use should be checked before despatching convoys along them. Helicopter reconnaissance and infra-red photography should indicate where the ground has been disturbed and may pick up fresh vehicle tracks with unusual tyre marks joining and leaving the track, tyre marks skirting a section of track which has been disturbed or footprints on a track which is only used by vehicles. Engineers should be readily available to investigate suspicious circumstances.
7. **Precautions.** When mining is likely:
 - a. Vehicles should stick to cleared hard top roads or tracks.
 - b. Unless a track has been proven safe, it is better to move off it.
 - c. In convoy, on or off tracks, vehicles should follow in the tracks of the leading vehicle.
 - d. Frequently used crossing places in defiles should either be permanently watched or avoided.
 - e. Vehicles' floors should be sandbagged, V—shaped armour plate fitted below the driver's cab, engine and transmission. The sides should be fitted with makrelon.
 - f. Small vehicles should be fitted with roll bars. Drivers and passengers should be strapped in.
 - g. Passengers in larger vehicles which do not have roll bars should not be strapped in.
 - h. Vehicle doors, windows and windscreens should be removed, as for normal desertization.
 - i. Vehicles should travel slowly enough for the driver and vehicle commander to watch the road surface carefully and to minimise damage and casualties if a mine is struck.

CHAPTER 4

TRAINING FOR OPERATIONS

SECTION 1 - THE ORGANIZATION OF TRAINING

The Collective Aspect

1. ***Adapting Existing Doctrine.*** A force sent to a desert theatre will fight with the equipment it has and in accordance with current doctrine. While equipment and doctrine can be modified to suit the new environment, much will depend on how well officers and men, battle groups and formations have mastered their individual training, learned how to live on a vehicle basis in the field, developed battle procedures based on sound SOPs and perfected all arms tactics. Armoured units and formations which have trained in Germany and at BATUS in Canada will have the basic technical and tactical skills which can be adapted for desert warfare. The approach to battle begins on the training area in the years of peace before a war in an arid country. Provided that the troops, their commanders and staffs are well trained they can adapt quickly to the peculiar conditions of the new environment. If their basic and collective training have been neglected no amount of desert lore will remedy the defects.
2. ***Training of Formations Warned for Service Overseas.*** In the worst case, the sudden despatch of a formation from the UK or Europe to a desert theatre with the minimum of notice to meet a sudden emergency, it will only be possible to improvise a training programme as opportunity offers. There may be a chance to train during the concentration period and on the move up to the forward area. Should action not be imminent it will be possible to draw up a plan for training in the home location before the move and after arrival in the theatre. Activities and responsibilities may be organized on the following lines:
 - a. *Home Location*
 - (1) HQ LAND will take over responsibility for the formation's training in its peacetime location to relieve the formation headquarters, which will be fully occupied moving overseas, planning future operations and organizing in-theatre training.
 - (2) Training in the home location will usually concentrate on:
 - (a) Completion of unit training including weapon firing.
 - (b) Specialist training, employing teams of specialists to teach the use of new equipment.
 - (c) Familiarization with the new theatre, including topography, mapping, etc, using feed-back from the new theatre.
 - (d) The absorption and training of reinforcements and battle casualty replacements.
 - (e) If time allows during the preparation of vehicles and equipment the CSS units should be given the opportunity for individual training, shooting and basic defensive skills.

- (f) Medical training to prepare for the heat and hazards of the new theatre.
- (g) Training is likely to be restricted because vehicles and heavy equipment will almost certainly be despatched by sea in advance of the troops who will fly out later to marry up with their equipment on arrival.

b. *In-Theatre*

- (1) *Training Commanders and Staff.* Map exercises (MAPEXs) provide the best medium for a formation commander to introduce his subordinates and their staffs to his concept of battle. The battle drills and CSS procedures used in Europe will be adapted to the theatre and provide the basis for the revision of SOPs. With commanders and staffs at all levels thinking and operating along the same lines it will only be necessary to issue brief oral orders in action.
- (2) *Movement Exercises (MOVEXs).* The training of commanders, operations and CSS staffs down to unit level on MOVEXs provides the foundation for movement planning and control. The system will be validated on FTXs and may lead to the introduction of new concepts, such as the division of responsibility between the formation headquarters for control and a special headquarters, based on an engineer unit, to regulate movement, develop a main supply route and recover vehicle casualties.

c. *Unit Training*

- (1) Units will be responsible for individual and sub-unit training.
- (2) Formation headquarters (brigade and functional headquarters, such as a fire support group (CRA), engineers and the divisional support group (DSG)) organize special-to-arm MAPEXs and field training to fit in with the higher formation commander's concept of battle.
- (3) Desert ranges have to be cleared with the local authorities and constructed by engineers for small arms, tank commissioning, artillery and engineer equipment. Field firing should be carried out at squadron/company group and battle group levels. The impact area should be large enough to allow for the practice of close air support. Battle inoculation should be included in the training programme.
- (4) Dry training areas must be allocated for battle group and formation tactical training. It is relatively easy for engineers to construct mock-ups of enemy defences in the desert so that tactics for attacking them may be practised.
- (5) Formation training should include the integration of brigade support groups (BSGs).
- (6) Track mileage restrictions may restrict tactical training. Sufficient spares and repair effort should be organized in the planning stage to provide for wear and tear on training as well as in the coming battle.

d. *Collective Training.*

- (1) It will be necessary to establish liaison and a good working relationship with the allied headquarters to which the British formation is to be subordinated and those allied formations with which it will cooperate, either on its flanks or on passage of lines operations. The opportunity should be taken to work out joint procedures.
- (2) CPXs and FTXs are not merely essential for the training and tactical integration of battle groups and formations together with their fire and logistic support. They also provide the opportunity to rehearse and refine the procedures for future operations.
- (3) The move of the formation up to its assembly area may provide the only opportunity to manoeuvre a complete division by day and night and to practise major tactical and logistic regrouping.

3. **Acclimatization.** The physical and medical aspects of acclimatization and living in the desert have already been covered. As far as peacetime training in a hot desert is concerned the initial prerequisite is a high standard of physical fitness. The soldier will still need a fortnight to a month, depending on the season, to acclimatize but the process will be quicker and the individual will suffer less discomfort if he is fit in the first place. This does not just apply to infantrymen. It applies to everyone because a fit man can stand the heat of an armoured vehicle better than an unfit man and if a tank, an IFV or an APC is knocked out the crew may have to walk a long distance. The time available for training in overseas countries is limited for financial and political reasons, and because units must give priority to their normal tasks and commitments. Clearly there is an advantage in planning overseas exercises for the cool season so that the maximum time can be spent on tactics at squadron/company group, battle group and formation level. The shorter acclimatization period can be put to good use on the individual, specialist and small group training aspects discussed below. In an operational setting there may be one of two scenarios:

- a. If the host nation has asked for assistance in good time the potential enemy may be deterred, temporarily or permanently, from aggression and the troops will have time to acclimatize, although they may have to prepare positions, repair equipment and handle stores¹. At least the work load can be increased gradually and much of the heavy labour done in the cool of the evening and early morning or at night.

1. The British concentration in the Gulf in 1958 and the arrival of British forces in Kuwait at the Ruler's request in 1961 deterred an Iraqi attack on both occasions. Although troops stationed in the Arabian Peninsula were acclimatized and those from Kenya and the Mediterranean partially so, those from the UK were totally unprepared for the blistering heat and humidity of a Gulf summer. Fortunately, the rapid American concentration in Saudi Arabia following Iraq's invasion of Kuwait was not followed by immediate hostilities in the hot season. If Saddam Hussein had further designs on Saudi Arabia the American intervention may have deterred them. The weather was beginning to cool down when 7th Armoured Brigade arrived in the Gulf.

- b. If deterrence fails and the intervention forces are plunged straight into action the commander can only try to keep the tempo of operations initially at a level which his troops can stand in the heat of the day and make his main effort at night. This will not be easy as the enemy will have the initiative. Much may depend on good night observation devices and sights for fighting at the time of our choosing, and on armed helicopters and air support bearing the brunt by day, although this will sorely test air and especially ground crews.
4. ***Desert Tactics.*** Initially, the enemy, familiar with the theatre, may have the tactical edge on our forces. While our troops are learning how to live in and adapt their tactics to the new environment their force commander would be unwise to attempt too ambitious a plan. It takes a little time to gauge what is and what is not possible in a new environment in terms of the time it takes to cover a distance over various types of going, the effects of light and haze on judging distance and ranges, the optimum conditions for bringing on an engagement, the enemy ruses and tricks to watch for and how to carry out such mundane tasks as replenishment on a battlefield with little cover. Commanders at all levels will have to learn fast and make up for their inexperience with a mixture of common sense, resourceful improvisation and the mental flexibility to adapt their existing equipment and tactical doctrine to the new scene. The highest British formation headquarters in the new theatre can help to redress the balance in expertise by issuing training notes, illustrated with simple diagrams, to explain the commander's concept of operations. This will ensure a uniformity of doctrine so that subordinate commanders will train their formations and units to fight in accordance with the same concept. A common doctrine helps to save time in giving out orders and enables commanders to think and act within a logical framework of conceptual operational and tactical ideas when the unexpected occurs and they have to work on their own initiative.
5. ***Reinforcement and Training Organization.*** A training organization, based on an armoured delivery organization, should be established to acclimatize and train individual reinforcements arriving in the theatre before they are sent forward to join their units. With the passage of time it will be possible to withdraw suitably experienced officer and NCO instructors from units in the line to provide the staff. The reinforcements coming in from the UK will benefit from the experience of desert veterans and the veterans will obtain a well-earned rest. Care should be taken in the selection of instructors. They should not be those whom commanding officers wish to be rid of or who cannot resist an opportunity to inflate their egos in front of a captive audience of tyros but men who will command the respect of the newcomers, pass their experiences on to them in a helpful way and be a credit to the units from which they came. It may be possible, and wise, to structure the training organization to reflect the composition of the force so that the reinforcements will, as far as possible, go to the units or formations from which the instructors came. The size of the organization will reflect the strength of the British contingent. A brigade-sized force might have a sub-unit, a division a lieutenant colonel's command while a still larger force would justify a commensurate organization. At divisional level an armoured delivery regiment (ADR) should be set up. It should be capable of sending forward an element, an armoured delivery group (ADG), to help reconstitute a brigade during a suitable pause in operations.

6. **Formation Training.** Occasionally, it will be possible to pull a complete formation out of the line for a rest. Having enjoyed some well earned local leave the formation should reassemble for training, taking the opportunity to rectify deficiencies in those technical and tactical aspects which battle experience has revealed. If the enemy has introduced new and better weapons and equipment to swing the balance in his favour this would also be the time to work out ways of compensating for the disadvantage with changes in tactics and guile. Formations which are withdrawn and sent to another part of the theatre to meet a possible threat should not be allowed merely to prepare positions and sit in them. They must continue training for mobile operations.
7. **Introduction and Absorption of New Equipment.** A break from the line also provides the opportunity to absorb and train on new equipment. As a policy, it is better to re-equip and retrain complete formations with a new weapon rather than hand it out in small packets throughout the force. Not only is a formation more effective if its units re-equip and retrain all together but the problems of repair, spare part and assembly replacements, ammunition supply and the training of subsequent reinforcements is simplified. This provides a further argument for organizing the reinforcement training unit in a way which complements the order of battle.

The Individual Aspect

8. There are a number of basic topics which must be mastered by everyone who fights or works in the desert, whether as commander, specialist or soldier. They are:
 - a. Adapting to the environment.
 - b. Map reading and judging distance.
 - c. Survival and search procedure.
 - d. Escape and evasion.
 - e. Concealment and camouflage.
 - f. Enemy organization, tactics and equipment recognition.
 - g. NBC training.
 - h. First aid. See Chapter 1 for further details on acclimatization and heat illnesses.
 - i. Mines and booby traps.
 - j. Helicopter marshalling, including briefing helicopter pilots to use terrain cover on approach and departure.
 - k. Desert driving, at least for all commanders and crew members, in addition to the normal establishment of drivers and reserves.
 - l. The adaption of tactics to the environment.

- m. The local scene and customs.
9. Certain individuals need to be trained in particular desert skills.
- a. *Desert Navigation.* All commanders, including those in charge of echelons and CSS units, need to be able to use the current satellite navigation system and the more traditional methods in case the satellite system receiver should fail.
 - b. *Desert Search and Rescue.* Everyone should be aware of the techniques. Any officer may be called on to organize a search.
 - c. *Affects of Desert and Climate on Equipment.* Each specialist must be competent in his own field.
 - d. *Local Language.* Every unit should aim to have at least one person capable of speaking the local language colloquially. Force headquarters will provide interpreters when necessary. Because many place names are descriptive a navigator will know what kind of feature to look for on the ground.
10. The next Sections explain only those subjects which are peculiar to the desert or which are noticeably affected by it. Many subjects merely involve adapting basic military skills to the new scene and circumstances.

SECTION 2 - ADAPTING TO THE ENVIRONMENT

Familiarization

11. **Confidence.** The soldier who is taught how to live and move in the desert, how to use what cover there is for concealment, how to find his way and what to do if he is lost will begin to feel confident in the environment. Soon he will take pride in being a 'desert rat'. But familiarity can breed contempt and the desert is unforgiving to those who disregard its lore of elementary precautions. Chapter I explains the environment in terms of terrain, climate, living and its effect on equipment. It provides a general background for basic training in desert operations which can be adapted to the country and climate of the new theatre. The following paragraphs outline a framework for training.
12. **Acclimatization.**
- a. In training, not too much should be expected too quickly and on no account should any restriction be placed on water consumption during the acclimatization period.
 - b. The time taken to acclimatize depends on the season and latitude. Men should acquire a tan gradually, stripping to the waist for only 15 minutes a day to start with and increasing the period by 5 minutes a day. Anyone feeling a burning sensation, or seeing someone else's skin turn unduly pink, should don his shirt or tell the other person to do so.

- c. Physical training and any arduous work should be carried out in the early morning or the cool of the evening. Gradually, the work load should be increased so that by the end of a month in hot weather men are capable of doing hard work, marching and fighting in the heat of the day. If troops arrive in a desert in torrid heat at the height of the hot season it may be necessary to start by training and working at night and resting by day. Even when acclimatized, heavy work should be avoided in the middle of the day whenever possible, especially in extremely hot deserts, but should the operational situation demand it, men should be capable of undertaking it. In such circumstances unrestricted water is essential and men should be encouraged to drink freely. Acclimatization can be accelerated by working men in the heat so that they sweat profusely. Although, as mentioned earlier, 80% acclimatization may be achieved in four days and 100% in a fortnight, men will lack stamina.
- d. Officers and NCOs should watch carefully for men showing signs of heat exhaustion and dehydration. Everyone should work on the 'buddy system' in order to spot trouble early.
- e. The medical officer will advise if extra salt is necessary. When training unacclimatized troops, units should, whenever possible, seek advice from the nearest medical unit regarding the current Heat Stress Index. This provides a useful guide to relate the amount of physical exercise to the climatic conditions.

First Aid and Health Training

- 13. Because casualty evacuation may be difficult in the open desert, by night as well as by day under the eyes of the enemy's surveillance coverage, and because the hygiene hazards present a higher degree of risk than in a temperate climate, all ranks must be proficient in first aid and health including health hazards in hot climates. The ability to give artificial respiration, stop bleeding and treat shock may make all the difference between the survival and death of a wounded man.
- 14. Particular attention should be paid to training in the following subjects:
 - a. *Water Discipline and Sun Discipline.* Everyone should be trained in the conservation and use of water, its purification and in the dangers of exposure to the sun.
 - b. *Heat Illnesses.* Everyone must be taught to watch for the symptoms of heat illnesses, both in themselves and in others.
 - c. *Snake, Scorpion and Spider Bites.* First aid treatment and reassurance of the casualty.
 - d. *Personal Hygiene.* The need to wash down whenever the opportunity offers and elementary camp sanitation.
 - e. *Local Food and Drink.* Men must be warned not to buy food, drinks and ice to cool drinks from local vendors. It may be necessary for the RAMC to vet cafes and restaurants in local rest and base areas.

- f. *Tropical Illnesses.* All must be trained in measures to avoid contracting diseases endemic to the area, eg, anti-malarial and anti-sandfly precautions.

Protection from the Elements

15. **Light.**

- a. *Glare.* The glare of strong sunlight reflected by sand and refracted from the atmosphere is a strain on the eyes and tiring. Dark goggles or sun-glasses should be worn but must be shielded to prevent give-away reflection from the sun.
- b. *Reflection.* The object lenses of binoculars must be shielded from the sun for the same reason.
- c. *Map Boards.* Whether or not covered with talc they must have cloth covers. Dismounted infantry officers should not carry map boards at all. Their maps should be folded small enough to stow in a pocket when they are not actually being used.
- d. *Optics.* Periscopes in tanks, IFVs and other vehicles must be covered at night when not being used to prevent the light in turret, driving compartment or cab being picked up by enemy image intensifiers, thermal imagers or infra-red viewers. With such instruments even the low levels of light in armoured vehicles can be seen for miles.

16. **Heat.** The current cotton desert combat dress is cool, loose and comfortable. In really hot deserts, it may be necessary to produce even lighter clothing.

17. **Wind.** Wind chaps the face and constant exposure to blown sand is at best irritating and can be painful. A cloth head cover, worn like a keffiyeh, gives good protection. A map opened out in the desert wind is soon shredded. It should be folded and stowed in a pocket, as mentioned in paragraph 15c above, or kept in a small map case, covered with camouflage material, where it can be protected and hidden from view. Papers must be secured so that they do not blow away.

18. **Rain and Cold.** A pullover is useful at night in all but the hottest seasons. Winter nights can be bitterly cold, cold enough to wear temperate combat dress by day as well as by night. Waterproof clothing may be needed during winter rainstorms near the coast. During the rainy season avoid digging or bivouacing in wadis which are liable to flash floods.

SECTION 3 - MAP READING, JUDGING DISTANCE AND THE CONTROL OF FIRE

The Map in Relation to the Ground

19. ***A Matter of Scale and Detail.*** It will be manifestly obvious to the newcomer that not only is there apparently less recognizable detail in the desert landscape but often far less detail on the map. The qualification 'apparently' is used advisedly because, with familiarity, the soldier will develop the bedou's eye for the seemingly trivial feature, unremarkable to the soldier born and brought up in the city or countryside, but which provides a landmark for the desert traveller. With a little practice the soldier begins to appreciate the distinctive shapes of individual sand dunes, outcrops, boulders, wadi banks, bushes and acacia trees. Officers and soldiers should be taught to make an estimate of the ground in terms of thousands of metres or in kilometres and not to take too parochial a view of the landscape. Maps may be small scale and not very accurate. With practice the soldier will discover the kind and size of feature the surveyor considered worth recording on the map and will learn what sort of a hill, outcrop, well or wadi he can expect to see on the ground when he looks at his map.
20. ***Contour Reading and Hachures.*** The survey in a reasonably well mapped desert will show contours. In country where hills, mountains, escarpments and large dunes are the main recognizable features map reading is virtually contour reading. This is a skill which only those operating in mountains and deserts acquire and a conscious effort must be made in teaching desert map reading to master it. It is important to ascertain whether the contours are in feet or metres. In less well surveyed regions features will be shown by hachures, elevation being shown by a few spot heights or trigonometrical points. While hachures give a rough and ready idea of the lie of escarpments and mountains they are not much help with the registration of targets and the adjustment of fire, because they give no inkling of the height of a target and only a poor indication of the conformation of the ground.

Relating Events on the Ground to the Map

21. ***Panoramas and Sketch Maps.*** In badly mapped country it is essential to have a system for pinpointing activity on the ground and reporting its position accurately to higher headquarters. In defence there will often be time for battle group and artillery OPs to draw panoramas and for intelligence sections to make sketch map enlargements showing additional topographical detail, the location of minefields and the position of mortar and artillery DF and FPF tasks.
22. ***Briefing Visitors.*** A pointer staff is a useful aid for indicating features quickly to others in a barren landscape. In a static position panoramas and range cards are useful tools for pointing out the ground to visiting commanders, patrol leaders and O groups.

Judging Distance

23. ***Long Views and Contrasting Lights.*** The long views, the markedly different appearance of features when looking with or into the sun and the variation in the length of shadows from a pronounced elongation in the early morning and late evening to

their virtual disappearance at midday in the hot season exaggerate or reduce the observer's sense of perspective. The newcomer will make gross errors in judging distance, tending to overestimate when looking against the sun and to underestimate when looking with it. The old rule of thumb, 'Light's up, sights up', observing downsun can be applied to the desert with another saw, 'Estimate the range and double it.' On a dull day, when there are no shadows, there is very little sense of perspective and range estimation in a new piece of terrain is not at all easy. On a hot day range estimation either optically or with a laser is virtually impossible through the mirage in a flat desert. Advantage should be taken of any high ground, which offers a view above the heat haze, to improve accuracy.

24. **Developing a Sense of Scale.** All ranks, and particularly officers and NCOs who control fire, direct or indirect, must practise judging distance. A good instructor, with the help of a map and a panorama, can give his students a sense of scale and distance in different kinds of light.
25. **Establishing Ranges in Defence.** Ranges to recognizable features can be measured off the map and noted. Cairns can be built at paced intervals in a sub-unit's arc of fire to provide a guide to range.² During the preparation of defences the position of minor features can be determined by resection, laser range finders³ or firing rounds from accurately surveyed gun positions. At the lower end of the scale, range cards should be prepared in every section position and panoramas in battle group OPs. At the higher end of the scale, officers and NCOs, especially in armoured reconnaissance regiments and long range patrols, should get a feel for estimating the distance to features and to large clouds of dust caused by enemy movement out to twenty miles.

Control of Fire and Weapon Training

26. **Direct Fire Weapons.** The temptation to engage at long range with small arms must be resisted in the desert. Not only is fire likely to be ineffective, especially if the range cannot be estimated accurately, but the firer will give his position away needlessly to suffer retaliation from artillery and armour. Troops must be taught the added value of defilade and reverse slopes so that engagements can be brought on within effective range and from positions which are difficult for the enemy to pinpoint. Fields of fire and the moment for opening fire should be selected to surprise the enemy and to catch him in the open where there is minimal cover and no easy escape route. The use of defilade and reverse slopes will also make it difficult for the enemy to provide mutual direct fire support or observed indirect fire to extricate his exposed tanks, APCs/IFVs or dismounted infantry. However, tanks can be used in a sniping role at long range to impose caution on the enemy and to pick off command tanks or APCs/IFVs which can be recognised by their pennants, call signs painted on their turrets or by their behaviour. Sniping tanks should use defilade, change position carefully to raise the

2. An aid to judging distance the Boers under De La Rey used at the Battle of the Modder River on 28 November, 1899 when they spread whitewashed stones across the veldt at different ranges.

3. Binocular type laser range finders are accurate up to 10 metres out to 4 to 6 kilometres.

minimum of dust and act as additional OPs to report enemy movements. Because the discharge of a tank gun raises clouds of dust to obscure the target the tank commanders within a troop should be practised in spotting each other's strikes. Automatic weapons suffer from the same problem. The sandbags on the ground in front of an automatic weapon should be dampened to reduce the dust problem and an observer, perhaps the second-in-command of an infantry section, should observe and correct its fire if the dust problem cannot be controlled.

27. **Night Firing.** Training, either on arrival in a desert theatre if the opportunity arises before being committed to battle or during rest periods, must include night firing so that infantrymen and tank crews become accustomed to using their sighting aids over longer ranges in very different light conditions. A full moon produces conditions similar to daylight but in monochrome.
28. **Artillery Observation and Correction of Fire.** When bracketting a target the rounds which fall short are likely to obscure it with clouds of sand. Having obtained the range with a laser rangefinder it may pay to fire beyond the target and creep down. When there is a great deal of dust in the target area white phosphorous may be useful in identifying ranging rounds.
29. **Anti-tank Guided Weapons.** ATGW controllers should be sited on rising ground above the heat haze so that they can guide their missiles on to their targets more easily. Care must be taken not to occupy the obvious high points which are likely to be included in the enemy's artillery covering fire programme. OPs should be selected which offer views over a field of fire downsun for as much of the day as possible.

SECTION 4 - ALL ARMS TRAINING

General

30. Hopefully, a complete formation will be sent to the new theatre, one which has trained together in battle groups in peacetime. Commanders at all levels will know each other and will have developed and established the skills needed for fighting in teams of all arms. Units which are plucked from garrisons and different commands to form a scratch force to meet a sudden emergency will not be so lucky. It can only be hoped that they will have time to train together, form the nexus of close interarm relationships and practise the drills and skills needed for the various phases of war before being pitched into battle.
31. Provided that the basic all arms expertise developed in formation training already exists, tactical training will concentrate on adjusting known techniques to a bare landscape. Armour and armoured or mechanized infantry must become used to operating over wide areas of seemingly featureless desert. Battle group and squadron/company group commanders must become accustomed to appreciating ground and judging distance on a wider scale than in central Europe or the UK. They will develop an eye for the apparently imperceptible fold in the ground which offers a covered approach or a hull down fire position. Except in the set-piece attack, when the frontage is restricted by impassable obstacles on the flanks, the emphasis will be on manoeuvre to outwit and outflank the enemy. In the open desert the tank, the

armed helicopter and the guided missile, supported by artillery, will tend to dominate the battlefield. Infantry will be required to protect the guided missiles and, supported by the other arms, deal with enemy infantry strong points which have been well softened up by preparatory bombardment and covering fire. The temptation to dismount infantry too soon should be resisted. Not only will they lack protection but they will no longer be able to move at the same speed as the tanks.

32. Battle group and squadron/company commanders will learn to keep a wary eye open for the enemy trap which may catch them in the open, halted by a minefield. In defence they will endeavour to force the advancing enemy into the same situation.
33. Changing tactical circumstances and the heavy casualties to men and equipment of battle between evenly matched opponents may oblige a commander to regroup. To accomplish this speedily the drills for regrouping should be thoroughly rehearsed. So, too, should the procedures for conducting reconnaissances, issuing orders, movement and deployment.

Night Operations

34. Night no longer provides the cover for the attacker it once did in the face of thermal imaging and image intensification. Second World War style dismounted infantry assaults across wide expanses of bare desert cannot be repeated. Night tactics will tend to resemble day tactics, with armour and mechanized infantry moving at the best practicable speed, preferably in outflanking manoeuvres and making use of terrain cover from night observation devices and radar as well as the human eye. They will need to be covered by the direct fire of other tanks and indirect artillery support to neutralize enemy armour, guided weapon operators and artillery observation posts as well as the enemy's artillery itself. Apart from the shock effect of shell fire, the clouds of sand thrown up by a bombardment will blind optical, thermal imaging and image intensification sights. TEWTs, followed by 'dry' and field firing exercises are the best way to accustom, first commanders, and then their troops to the conditions of desert warfare. Subsequent training may concentrate on developing techniques to meet the inevitable see-saw between attack and defence as new weapons are introduced in the course of the campaign.
35. Night operations are notoriously difficult to control. Even with good optical aids it is not easy to maintain direction and to ensure all arms coordination at combat team level in the dark. Night operations should not be too ambitious until commanders and troops grow used to the environment. Should timings go awry the attacking troops may find themselves fatally exposed in the open at dawn. With experience, commanders will be able to assess with increasing certainty the capabilities and limitations of their battle groups in night operations and to calculate the time it takes to move over different types of ground in the dark. Lessons learned and new ideas can be tried out on exercises when a formation is resting out of the line. Soon, commanders will have the confidence to launch an ambitious and daring operation which will take the enemy by surprise, knock him off balance and retain the initiative in the knowledge that their all arms teams are well enough trained to carry them to a successful conclusion.

SECTION 5 - NBC TRAINING

Background

36. For the effects of NBC weapons on desert operations see Chapter 9 of Part A. The reader is assumed to be *au fait* with NBC matters. This section covers only subjects which apply particularly to a desert setting and which should be included in training or briefing if there is a NBC threat.

Briefing

37. **The Nuclear Threat.** If there is a possibility that nuclear weapons may be used, all units in the FCZ, the RCZ and the CSSG will have to dig shelters, keep protective clothing handy and take the precaution appropriate to the state of alert.
38. **The Chemical Hazard.** Since chemical weapons were used in the recent Iran-Iraq war, troops should be warned to expect a chemical agent attack during the night-time temperature inversion described in Chapter 9 of Part A. The other likely time is in the morning, when persistent agents, sprayed on to the desert during the night, evaporate with the rising sun and drift over our positions with the prevailing wind. An attack may follow on the heels of a chemical attack, hoping to find the defender confused. In a stalemate situation an enemy may use chemicals, particularly persistent agents, in a harassing role at unpredictable times in order to force us into living and sleeping masked and protected in stifling heat. At night a chemical attack may be difficult to distinguish from high explosive harassing fire and so the risk of being caught unprepared in the middle of a bombardment when it may be difficult to hear the NBC sentry's warning might oblige us to live in considerable discomfort. Troops should be warned of these hazards so that they are not taken by surprise and understand the need for putting up with the hardship. COLPRO will be available if there is a chemical attack risk. Should it not be available for some reason it should be possible to build chemical agent proof shelters with airlocks, the type which were used during the First World War and were a feature of air raid precautions just before and during the Second World War.
39. **The Biological Hazard.** Because of the difficulty of mounting an effective biological attack in high ambient temperatures, which kill bacterial agents, the long incubation period and the uncertainty of gaining a decisive military advantage to offset the odium incurred on the international political plane, such agents are unlikely to be used in the field. If an enemy employs biological weapons he is likely to use them more subtly to contaminate water, food supplies or a civilian population already living in an unhealthy environment. However, troops should be warned to report any unusual symptoms, even if it only turns out to be the unsettled stomach problem common to most hot climates. If a soldier has reason to suspect a source of water or food he should warn his commander or medical officer and bottle a sample.

Training

40. Should there be a NBC threat, the standard precautions laid down in the appropriate publication⁴ should be thoroughly rehearsed. This not only provides individual and

4. Manual of Nuclear Biological and Chemical Defence Training on Land, Pamphlets 1, 2 and 3, Army Code No 71328 (Pam 1), (Pam 2) and (Pam 3).

collective protection but the mere fact that troops ordered overseas are properly trained may persuade the enemy that the chances of a battlefield success are so remote that the employment of such agents would not compensate for possible retaliatory measures, perhaps of a different order, and the international opprobrium that their use would attract.

41. It will be necessary to practise protective measures in the theatre both to ensure the safety of our own troops and to make certain that the enemy knows we are prepared to meet a NBC threat. At the same time, care should be taken not to provoke an unwelcome escalation. Hard though it will be to wear, train and even sleep in protective clothing and masked up in a hot climate, the effort must be made. Medical advice must be sought as to the duration of such training and the amount of work that may be permitted. The training must be appropriate to the state of acclimatization and fitness of the troops. Once again, a good state of general physical fitness will ease training and make the ordeal of an attack more sustainable should it ever materialize.

SECTION 6 - SUMMARY

42. The desert is a demanding environment. Those who do not learn to live in it and train in it realistically will be severely punished in battle. Those who are accustomed to the environment by constant training, who have learned to navigate in it, who know how to take advantage of its extraordinary light conditions and who can turn its going and terrain cover to the best advantage have little to fear.
43. In a desert battle the situation can change with alarming rapidity. Threats develop suddenly out of the blue or through the clouds of dust and smoke which are so characteristic of operations in sandy wastes. Not only must everyone be trained to maintain a constant vigilance, watching in every direction, but exercises should be stage-managed to produce unexpected situations. The good exercise director will invent incidents to tax the ingenuity of commanders at all levels and to cultivate their ability to react rapidly to unforeseen circumstances.

DESERT OPERATIONS

PART C HISTORICAL SUPPLEMENT

SECTION 1 - ARRIVING IN A DESERT ENVIRONMENT

US TROOPS ARRIVE IN SAUDI ARABIA - AUGUST 1990

IN SAUDI ARABIA -The sun was searing the desert floor at 110 degrees when marines of a rifle company were ordered into full chemical-warfare combat gear. They struggled, panting and sweating, into thick coveralls, black rubber boots and masks that left them looking like a troupe of Darth Vaders.

Twenty minutes into the practice drill, one marine went down, collapsing in a green heap on the sand. "Get his jacket off -cool him down!" shouted one of his colleagues as others ripped his mask off and began pouring bottles of water over his head.

In Saudi Arabia, heat has become the most hostile enemy of U.S. troops. Even more than the nearly 200,000 Iraqi soldiers massed across the Saudi border in Kuwait, the brutality of the sun has been the most dominant force in shaping the initial operations of American ground forces here.

It has prompted military commanders to slow planned operations and has radically disrupted training routines. It is reshaping the lives of even the most hardened marines and soldiers, exacerbating already austere and stressful conditions.

"The hardest thing we're dealing with here is the combination of the heat, the hours, the sand and the dust," said Captain Adrien Burke, 29, commander of the U.S. Marine landing-support detachment that is directing the flow of the tons of Marine equipment being flown into Saudi Arabia. "It makes for long, dusty days and short, sleepless, uncomfortable nights."

The 20 men of Captain Burke's unit have been camped under a dust-covered tent on the edge of the airfield, without showers or hot meals, since they arrived 13 days ago. They dine on military-issue Meals Ready to Eat -from beef stew and scalloped potatoes to ham cubes or chicken à la king.

"The biggest break of the day is to sit in the shade and drink water," said Captain Burke, who, like every American commander on the ground in Saudi Arabia, orders troops to drink at least 4 to 6 gallons (15 to 23 litres) of water a day.

In the first days of Operation Desert Shield, many U.S. troops have spent as much time acclimating (sic) to the desert as they have establishing defenses for Saudi Arabia. "You never get 'climatized,'" grumbled a soldier from the Army's 82nd Airborne Division. "You just learn to tolerate it."

A Marine sentry guarding a group of tanks sought a fraction of relief by standing in the shadow of a skinny light pole. American troops have arrived in what is described as the harshest month for this region: the time of year when Iran and Iraq ceased most combat during their eight-year war because of the toll the climate took on both men and machines.

“When they opened the doors of the plane the first night we got here,” said one Marine, “I nearly had a heart attack - it was 114 degrees.” That is 45.5 degrees centigrade.

Many of the troops, who normally wear lightweight green jungle fatigues on exercises, say they have been dismayed to find that the new sand-colored desert fatigues are as heavy as winter uniforms, designed to stand up to the rocks and rugged desert terrain that would shred the thinner suits.

Commanders of the 7th Marine Expeditionary Brigade, arriving from three California bases, are rotating troops into the desert on four-day training missions in preparation for extended deployments on the monochromatic desert dunes.

After a few days under the Saudi sun, a growing number of commanders, including those of Marines on drills in the desert, have ordered their troops on “reverse cycle” - sleeping by day, training during the relative coolness of the night.

Extract from an article by Molly Moore (Washington Post Service) published in the
Herald Tribune Saturday-Sunday,
August 25-26, 1990

SECTION 2 - DESERT MOVEMENT

THE APPROACH TO SIDI REZEGH, NOVEMBER 1941¹

'We did a short night move, some 14 miles, and then two long day moves of 50 to 70 miles. These were easy, there was little dust and we rolled along, trucks 150 yards apart stretching far out of sight, a monotonous, never-changing procession like a convoy at sea. Then we started on the night moves. The trucks closed in until we were in 9 columns, not more than 20 yards apart and trucks almost head to tail. This was done just before last light each evening and meantime the provost sections went ahead planting posts with lanterns at ½-mile intervals along the intended bearing. All the brigades had different desert formations. In 4 Brigade at this time 20 Battalion led in 9 columns with companies abreast, 18 Battalion and 19 Battalion followed, each in 3 columns behind the flanks, and Brigade Headquarters and the attached troops, field, anti-tank and anti-aircraft gunners, sappers, Field Ambulance, and supply vehicles followed the centre 3 columns. Fully closed up there was a mass of over 800 vehicles on a front of some 200 yards and a depth of 1,500 or so. When dispersed in the day-time the front was about 1 mile and the depth anything up to 10.

'Brigade groups followed one another, so that when each closed up for the night move there were gaps between them of about nine miles and they had to halt with similar gaps to leave room for dispersion at daylight -always made forward and outward. We had practised movement in desert formation, by night and by day, very often. Every truck had its allotted place and everyone knew it. The division in the desert always moved on the one axis, marked by black diamond discs or by lights. Each formation and each unit had its regular and often-rehearsed drill for passing defiles, changing direction, dispersing and closing in, deploying to attack, or taking up a defensive position. One great advantage to commanders, staff officers, and dispatch riders was that once a truck was identified it was easy to find the headquarters of the formation, unit, or sub-unit to which it belonged, as relative positions were known and familiar and unchanged.

'This carefully studied and very often practised system enabled the Division to carry out many great moves, from Egypt to Tunisia, with comparative ease and speed. In time we came to think, not without reason, that we knew all that needed to be known about the movement and the manoeuvring of masses of transport in the desert.

'With every care and attention to system and detail these night moves were weary and slow. In the move into Libya it was my responsibility, as the Commanding Officer of the leading battalion, to lead the Brigade on to the line of lights and hold it on the line, which sounds easy enough. The vehicles of the Brigade ahead disappeared as they moved forward to concentrate. My first task was to find the three lights marking the brigade starting-point, and these were invariably where I did not expect them. If, as happened once or twice, I failed to find them before starting-time, the only course was to lead off on the correct bearing, peering anxiously ahead into the darkness until a light was picked up. At the time the provost people had a maddening habit of planting lights in hollows where these occurred at the

1. Major General Sir Howard Kippenberger, *Infantry Brigadier*, Geoffrey Cumberlege, OUP, 2nd Impression, 1949, pages 82-85.

correct half-mile intervals, and they would be passed altogether if there was the slightest discrepancy in course, or not seen until almost trampled under. Sometimes there were gaps in the line of lights, perhaps through one being knocked over and broken, and then we crawled on in acute anxiety until the next was picked up. In later times the provost detachments had learned more about our limitations and difficulties, planted their lights more frequently and prominently, and even let us know what spot in the desert they calculated to be the start-point. But the move into Libya remains in memory as a nightmare of anxiety.

'Apart from these difficulties the night moves were not easy. We used no lights and most desert is bumpy and uneven. Leading vehicles travelled at two and a half miles in the hour but there was unavoidable concertinaing, and the tail of a long column usually had to move in fits and starts at anything up to twenty miles an hour. Twenty miles was a long night march under normal conditions. The drivers could see nothing of the ground in front, those back in the column could only follow their leaders. One was constantly slithering down over steep banks, bumping against hummocks, falling heavily into abandoned slit trenches, or getting stuck in soft sand. But every difficulty would be surmounted, the lights were always found in the end, and a few minutes after daylight we halted and dispersed and every truck brewed up for breakfast. During the day the stragglers and cripples were brought in by the indefatigable LAD, and next night the performance would start again. The men could sleep during the day, but there were conferences and affairs of various kinds for commanders, and I was very short of sleep before the battle opened.

'We crossed the frontier into Libya through a gap made in the wire on the night of the 18th. A few miles on I lost the line of lights and worked farther and farther off-course in looking for them. It was undesirable to stop the column to take a bearing unless unavoidable. But I got a shock when Inglis came up from the rear, stopped me, and said 'Kip, you're ninety degrees off your course.' I denied it, but took a bearing and found he was right; in fact, we were more than ninety degrees off. I accordingly led on round to complete a circle, and my car travelling at three miles an hour, moved across the rear of the column, bounding along at twenty, on to the right track again. Very few knew that we had carried out this odd movement.'

SECTION 3 - RE-EXAMINING THE 'JOCK' COLUMNS: DISPERSION REVISITED

by Bruce Davey

According to the Shelford Bidwell, the British Army commenced the war in the western desert without any doctrine but with, '... a collection of military fads and fashions.' This essay will examine three strains of dispersion adopted by British command in the Middle East during WWII. They were known as the 'Jock' column, the 'brigade group' and the brigade 'battle group'. The first of these was named after J C 'Jock' Campbell, VC, DSO, MC. It was Campbell who devised the tactics of small mobile columns, which usually consisted of a few armoured cars, lorry-mounted infantry and troops of 25 pounder field guns and anti-aircraft guns. The purpose of these columns was to raid the enemy's rear areas and collect information. Paternity of these tactical formations can be traced to the Support Group of the 7th Armoured Division. The Support Group was supposed to have provided the hinge upon which the two armoured brigades of the division operated. As commander of the Support Group's batteries of Royal Horse Artillery, Campbell was universally acknowledged as a fighting commander, a reputation which he shared with the 1940 Commander of the Support Group, W. 'Stafer' Gott. The celebrity of these two tenacious fighters had the unfortunate side-effect of enhancing their views on tactical organisations to such an extent that a useful minor tactic became elevated into a major one.

Several factors combined in the adoption of the tactics of dispersion. The British Army had undergone a dual development prior to WWII. At home, the Army gradually rebuilt and reorganised during the thirties. It was a process hampered by entrenched rivalries between the arms of the service, and by proponents of change and modernisation and hidebound elements remaining from the Great War. The outbreak of WWII hostilities saw the British Army in doctrinal disarray. The field army in the Middle East was unable to instigate any needed doctrinal and organisational changes before the political decision was taken to attack the Italian colonial possessions in Africa.

The results of Operation COMPASS, Western Desert Force's successful expulsion of the Italian army from Cyrenaica, perhaps made too lasting an impression on British commanders. The figures were beguiling! Marshal Graziani's numerically superior force had been overrun in 58 days. One hundred and thirty thousand Italian troops and 845 guns were captured. Three hundred and eighty light and medium tanks were destroyed. These figures held a compelling logic and left a persuasive legacy. The lessons learnt from Western Desert Force's campaign were later published as a volume of narrative accounts and procedural cribs which fell short of taking the place of validated doctrine and, whilst identifying Italian shortcomings, tended to underestimate the benefits of the 7th Armoured Division's excellent desert training.

In retrospect, British victory in this example of the offence at the operational level was not entirely dependent on the tactics employed by the victors. Lucio Ceva's assessment cites Graziani's failure to maximise his potential for mobilising infantry by means of the available motor transport as a significant factor. The Italians were quickly made aware of the superiority of the British Matilda tanks which demonstrated a marked technical edge over their own M-11s and M-13s. Even though the latter mounted an effective 47mm gun, it was very slow. Although never much predisposed to attack the British, the tank edge

affirmed the defensive mind-set of the Italians. This in turn encouraged the British to range widely over the desert. In order to avoid wearing down their tanks, the British resorted to the use of small columns of armoured cars and lorried infantry supported by field and anti-tank guns. This was how the 'Jock' columns were born and vindicated as a tactical formation.

The circumstances explained above had not motivated British commanders from the outset. General Wavell, Commander-in-Chief in the Middle East, had initially wanted General O'Connor, the Operational Commander, to use massed tanks. However, against the Italians, this was deemed inappropriate because the opening moves were against the static defensive positions of Nibeiwa, Tummar east and Tummar west. For the reduction of these locations, the concentrated artillery fire of the 7th Medium Regiment had been harnessed. In order to reduce the fortified cities of Bardia and Tobruk, a more orthodox mixture of artillery, infantry and tank forces had been required, but it was the dashing exploitation phase of Operation COMPASS which captured the imagination of British commanders and this was only achieved by stripping units down to their mobile elements and by the use of captured transport, often with the consent of their original drivers. Finally at Bed a Fomm, it was the mobile columns and light tanks of the British which took full toll of the Italian forces retreating along the single coast road. In the final battle of Operation COMPASS, the Italians aided the British by attacking in penny-packets rather than in concentrated waves.

On the battlefield, the tactics of dispersion had proved successful, but at that moment in the war, the greatest practitioner of dispersion acted at the highest strategic level. Redeployment of forces to Greece would allow the Italians to hold on to their North African position until 1943. With the coming of Erwin Rommel to Africa, the British Commonwealth forces would be faced with a very different style of warfighting. It was a new and shocking experience. Almost all the gains made in Operation COMPASS were lost. In less than three weeks, British Commonwealth forces, with the exception of those holding Tobruk, were swept out of Cyrenaica despite holding a ten to one numerical superiority. The incredible success of Rommel's first advances were due to the better use of firepower. The Germans used, '... airpower, artillery and the combined effects of direct-fire systems to gain strength at ... decisive points.'

The second variation of dispersion employed by the British in the clash of operational and tactical warfighting conceptions, was that of the 'brigade group'. This way of fighting, which was essentially the 'Jock' column writ large, dominated the thinking of British commanders until the watershed appointments of General Alexander and General Montgomery in the Middle East during 1942. It featured heavily in all major operations from 'BATTLEAXE' to Alam Halfa.

The 'brigade group' as an operational style was both forced upon the British by circumstances outside their control but was also a natural choice by a number of commanders. This method was embraced, not as the result of any doctrinal process but as an emergency measure. There was, of course, no time and no mechanism to conduct trials of these methods. Besides, Operation COMPASS has provided a recent operational vindication of dispersion. Scale was another area which found the British commanders wanting. According to Kenneth Macksey, '... the technique and practice of handling large mechanised forces in battle was only sketchily grasped.'

The objective of Operation BATTLEAXE was to bring the German to battle and to defeat it. New tanks had been rushed out to Egypt in the hope of achieving this victory by a Prime Minister eager to attack at all costs. The British armoured regiments now deployed a variety of tanks which determined the role of the units involved. For BATTLEAXE, the 7th Armoured Division contained two brigades, each of two regiments. The two regiments of one of these brigades possessed Matilda tanks whilst the other consisted of the faster but lighter and less potent A9, A10 and A13 cruiser tanks and the crusader tanks. The widely differing speeds of these vehicles suggested different roles and in the BATTLEAXE plan it could be seen that each of the tank regiments was to advance along different axes towards different objectives. The armour may have been designated as belonging to a divisional organisation, but in practice they fought dispersed into individual regiments, squadrons and even individual troops.

British tank tactics at this time included a preference for firing on the move, which gave little chance of accuracy. Tactics were characterised by incorrect assumptions about weapon characteristics. The British Command believed that the German 88mm FLAK gun could not penetrate the armour of the Matilda tank beyond 440 yards when they were, in reality, vulnerable out to a range of 2000 yards. It was in BATTLEAXE and the later Operation CRUSADER that the discovery was made that British tank gun shells disintegrated against German frontal armour. The opposite was not the case. The most vital and dangerous mission in Operation BATTLEAXE was that of the 7th Armoured Brigade. Tasked with contacting and destroying the German panzers, the cruiser tanks did not find their German counterparts of Hafid Ridge as expected. What they found was a well-concealed gun line of anti-tank weapons which 'brewed up' the first few tanks, causing the rest to veer away. As this force fought independently, it could not rely on artillery or infantry to dislodge the anti-tank guns on the ridge. The force that was designed to provide this additional combat power to the 7th Armoured Division was unable to assist, being involved in the most southerly of BATTLEAXE's independent thrusts. The Support Group of the Armoured Division seems to have engaged nothing more than open desert during the operation, getting into trouble in the Sidi Omar area. Their 25 pounder batteries would have added much-needed punch to the 7th Armoured Division's advance. With little to show for its employment in Operation BATTLEAXE, the Support Group's moves are reminiscent of the 'tactic' known as 'swanning', described in the War Diary of the Second Welsh Guards as, '... wandering the battlefield in an unspecified and probably unknown direction for an unnecessary and probably illegal purpose. John Ellis has summarised British tank tactics as being dominated by a persistent dissipation. The method of dispersion and the activity of 'swanning' went hand-in-glove.

It is not possible to examine in great detail each of the British offensives, but the concept of dispersion can be identified in each of them up to Operations LIGHTFOOT and SUPERCHARGE in 1942. Operation BATTLEAXE set up a lamentable precedent for the practice of 'penny-packeting'. BATTLEAXE, despite achieving some gains on the first day for the British, was found wanting on day two when the Germans concentrated their tanks and counter-attacked. They were greatly assisted in this by non-existent wireless security between British Corps and Army Headquarters. The defeat of Operation BATTLEAXE spelt the end for General Wavell in the western desert and emphasised command deficiencies. Dispersion of effort was the real culprit.

Operation CRUSADER was a rambling series of attacks and counter-attacks conducted over the period of November 1941 to early January 1942. It was an offensive involving

more units than Eighth Army Headquarters had ever before controlled and was perhaps the most notorious example of dispersion and the 'brigade group'. Nominally the force comprised seven divisions. Actually, none of the involved units fought as divisions and for the purposes of battle were dispersed into brigades and brigade groups. General Cunningham, Eighth Army Commander, was an artilleryman and inexperienced in the use of armoured forces. The operational plan that he inherited envisaged the three British armoured brigades of XXX Corps engaging and defeating the three Axis tank divisions, and, in concert with the infantry of the XIII Corps, advancing to meet a break-out force from the Tobruk garrison. Cunningham had first to deal with a dispute between the two corps for operational control of Brigadier Gatehouse's 4th Armoured Brigade group which included additional infantry and artillery. Cunningham compromised by giving the brigade to XXX Corps, but stipulating that it should stay close enough to XIII Corps to provide armoured support should this be needed to reduce the static German frontier defence. So it came about that this brigade group, which was considered vital to the attainment of both corps' objectives, was given a mission which precluded it from contributing to either.

In his book, *The Military Errors of WWII*, Kenneth Macksey labels the CRUSADER plan as faulty since it sought to match tank against tank. The three armoured brigades of this dispersed corps proved to be no match for the two German and one Italian tank divisions. But it was not only the tanks that split into brigades but the artillery regiments as well, '... split up between the infantry battalions and companies.' When the assault opened the British armour charged in the best cavalry tradition. John Ellis describes these headlong 'gallops' as bearing a strong resemblance to the lumbering 'ironsides' of Oliver Cromwell. Ironically, the British were about to learn the lesson of missile forces triumphing over shock forces that they themselves had taught the French at Crecy and Agincourt, only this time the boot was on the other foot.

The initial assault by XXX Corps 22nd Armoured Brigade was stopped at Bir Gubi by the Italian armour, whilst elsewhere successes had been achieved. At Sidi Rezegh, the 7th Armoured Brigade seized the airfield in an area dominating the eastern approaches to Tobruk, but as happened in BATTLEAXE, Rommel's panzers quickly concentrated and administered a battering to the widely dispersed elements of XXX Corps, and, foiling the Tobruk link-up they pressed westwards. With control slipping from his grasp, Cunningham panicked, and was quickly replaced by Neil Ritchie. In fact it was General Auchinleck himself who commanded the army which continued to grind on against the Germans.

The Germans had become overstretched and would surely have succumbed to a concentrated counter-attack, had it been within the capability of the Eighth Army to mount one. Allowed off the hook, Rommel withdrew from Cyrenaica with the British in pursuit. The Axis had sustained heavy losses, but CRUSADER had not been a decisive victory and on January 21, Rommel broke out of his El Agheila position yet again.

With the marginal success of CRUSADER, Auchinleck dispensed with the division as a fighting organisation. The last variation of dispersion was the brainchild of General Dorman-Smith who refined the brigade group concept even further. The brigade 'battle groups' were an offshoot of the brigade group. Each of the three battalions of infantry was allocated two field batteries of artillery, plus an anti-tank battery and expected to function independently. In order to accomplish this, the artillery regiments were dismantled a entities. Often employed in mined, defensive boxes, '... the general idea ... was that tactics

were now to consist entirely of columns built around 25 pounders with lorry borne infantry ... in an escort role.'

Rommel's assault on the Gazala - Bir Hacheim line almost resulted in his own destruction. The Germans encountered the new American Grant tanks. Although fighting dispersed in penny-packets, this tank packed a surprising punch with its 75mm main gun. Starved of petrol and ammunition and with all forces virtually prostrate, British Command seemed unable to complete the necessary regrouping of forces and change-over to the offence which ought to have nailed the desert fox in his 'Cauldron' lair once and for all. Like the witches in *Macbeth*, the Corps and army commanders brooded over their incredible catch. Eventually, '... (Ritchie) sat down to write a six-page explanation to Auchinleck asking for his approval.' Macksey relates that, '... it was all rather like a Staff College exercise in which the students submitted their written papers to the Directing Staff and waited for comments in red ink.'

By the second week in June, Rommel was able to escape from the 'Cauldron' and with the Eighth Army in flight, Tobruk fell by the third week and Rommel was promoted Field Marshal. Gazala had emphasised the bankruptcy of dispersion and it seemed that no matter how many blunders Rommel made, British commanders, '... the doctrine, technique and communications system required to defeat him.' Dissaffection with Auchinleck's methods bubbled to the surface, '... brought about largely due to a lack of an enforced common doctrine with clearly laid down rules of inter-arm co-operation.' At this time, with the Eighth Army and its commanders disintegrating, only Freyberg's New Zealand Division stood before the flood tide. Whilst Auchinleck was roundly disobeyed by many units, the New Zealanders and a few other units slugged it out with the weakening Panzerarmee throughout June and July of 1942 at Minqar Qaim and Ruweisat Ridge. By 13 August, Winston Churchill had sacked Auchinleck, replacing him with Harold Alexander, command of the Eighth Army eventually going to Bernard Montgomery.

This was the swan-song of the 'Jock' columns, brigade groups and the like but not of the inter-arms distrust that the experiment with dispersion had left as its legacy. General Montgomery demanded the concentration of artillery and tanks, reversing the trend for penny-packeting. In recent times, the brigade group/'Jock' column syndrome has been called by Brian Holden Reid, an attempt to develop combat organisations capable of conducting manoeuvre warfare. This attempt, '... (was) written off as unsound by Montgomery's admirers.' The historical accounts examined in this essay tend to show that it was not merely Montgomery's sympathetic biographers who were responsible for discrediting the methods of dispersion.

An analysis of German operations indicates some of the strong advantages they had in combat against the Eighth Army and its methods of dispersion. The Germans deployed their armour in divisional formations because combat had proven it to be the ideal unit size to maximise the effectiveness of the tank. Consequently, the operational mobility of the total force was increased, whether it be Panzergruppe or Panzerargade-size organisation in battle. Bryan Perrett writes that British regimental pride and closeness hampered the smooth addition of other arms, which when combined with an obsession with dispersion, resulted in failure against the balanced all-arms approach of the Germans. According to one of the most successful German commanders of WWII, Herman Balck, it was the organisational balance of tanks, armoured infantry and anti-tank guns that was the key to the combat power of the panzer division.

The Germans had not arrived in Africa with any magical doctrine which might automatically translate into victory. They were in the same boat as the British in the sense that the war had interrupted the relaxed formulation of a doctrine of modern armoured warfare. But what the Germans did have was a battle tested set of processes and unit drills known as *auftragstaktik*. Their methods required a high degree of command skills and accepted that battle was chaotic and that the exercise of command was an art not a science, requiring, '... a command and control philosophy which held failure to act as an illegality. This was much more complex than a simple organisational preference for dispersion or concentration. As General Toppe related, the Germans themselves dispersed their armour in the desert when need be, usually as a defensive response to British air superiority. It came down to the initiative of junior leaders and this has been cited as a great difference between the Germans and the British. The British showed a predilection for methodical set-piece offensives, and when these met with unexpected reversals, they lapsed into defence, whereas German leadership expected to have to adapt to the changing circumstances of battle. The need for initiative throughout the chain of command was in no way encouraged in the document 'Operations of Armoured Forces', yet by the time this had been superseded in 1942, initiative amongst junior leaders and the concept of concentration of force were both back in favour. Even so, a restrictive template for commanders' responsibilities in battle was still in existence.

Based on the above examination of the British methods, the inescapable conclusion is that British commanders really had no idea about the operational level of war at this time. Ad hoc formations and methods such as the 'Jock' columns and brigade groups were desperate, untried measures. But can the commanders be held solely responsible? It was not their fault that the development of armoured warfare doctrine in Britain had not proceeded along the favourable lines of the German model. Equipment deficiencies and the consequent limitations experienced in building the right mix of all arms combat formations combined with poor operational plans to rob the Eighth Army of any early decisive victory over the Germans. Commanders must, however, shoulder a portion of the blame since a series of them remained deaf to the advocates of concentration. Perhaps this was because many of these advocates of concentration were Dominion commanders.

The record shows that the 'Jock' columns, brigade groups and battle groups were failed experiments in the desert war against the Germans. Penny-packeting against the Italians was one thing, but against the Germans, a more thoroughly trialled and practised method was required. Dispersion brought out the need for a doctrine of modern armoured warfare, a doctrine, moreover, which would identify the need to concentrate force at critical points and not to disperse strength in faddish, but courageous, attempts to emulate the German methods of making war.

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SECTION 4 - SURPRISE, SPEED AND BLUFF

ROMMEL'S FIRST OFFENSIVE IN CYRENAICA

After the successful O'Connor offensive against the Italian forces in Cyrenaica (December, 1940-February, 1941) Wavell appreciated that it would be safe to replace his experienced formations, 7th Armoured and 6th Australian Infantry Divisions, the former to refit back in Egypt and the latter to take part in the ill-fated Greek expedition. They were relieved by a force under Neame: 2nd Armoured and 9th Australian Divisions, both newly arrived in the Middle East and only partially trained. Logistic difficulties obliged the latter to split its brigades between the western edge of the Gebel Akhdar and Tobruk, leaving only 2nd Armoured Division in the El Agheila-Mersa Brega area.

Wavell considered that the Italian forces in Tripolitania could be disregarded and that the Italian Navy would take months to move German armour to Tripoli in sufficient strength to launch an offensive. He reckoned without the arrival in the theatre of the dynamic Rommel on 12 February, followed by 5th Panzer Regiment, the forerunner of 5th Light Division, on 11 March. As the Panzer Regiment was only the equivalent of an armoured brigade the risk of attack was considered negligible.

So, on 24 March it came as a complete surprise when a British armoured car patrol at El Agheila was driven in. A week later Rommel attacked the screen itself at Mersa Brega. When his frontal attack was blocked Rommel improvised a quick flank attack backed by a deceptive show of force using dummy tanks, which had been constructed on Volkswagen chassis by his workshops in Tripoli, and other vehicles to raise huge clouds of dust. Neame was persuaded that he faced a vastly superior enemy and Wavell gave him discretionary authority to evacuate Benghazi if necessary. This Neame did when Agedabia fell on 2 April. Rommel exploited his success by advancing along four separate axes into Cyrenaica, adding to the impression of superior force as well as offering a multiplicity of threats.

O'Connor was sent back by Wavell to take over from Neame. Both were captured at Derna on 8 April by a German thrust directed across the chord of the arc of the Cyrenaican bulge. So to, were the commanders of 2nd Armoured Division and its armoured brigade. The British command system collapsed and by 11 April the Germans had overrun the whole of Cyrenaica with the exception of Tobruk, which resisted all attacks. Rommel's success was due to the surprise he achieved by attacking earlier than expected, deception to make his force appear more formidable than it really was and a relentless pursuit along several axes to disrupt the British defence and command structures.

SECTION 5 - OPERATION BERTRAM

THE DECEPTION PLAN FOR EL ALAMEIN

The Aims of Bertram

Operation *Bertram* worked on the principle that strategic surprise was impossible to achieve because Rommel was expecting an attack after his defeat at Alam Halfa. The aim was to deceive the enemy as to the date and the sector in which the main effort was to be launched. The outline deception plan, to delude Panzerarmee intelligence into thinking that the chief thrust would be launched in XIII Corps's sector in the south on 7 November, was Montgomery's idea as part of his overall operational concept which was to attack with XXX Corps in the north on the night of 23/24 October. He also wished to pin down the two Axis armoured divisions in the south, 21st Panzer and Ariete, until 27 October to prevent them from reinforcing the two armoured divisions already deployed in the north, 15th Panzer and Littorio, because their combined strength would effectively block Eighth Army's breakout.

The brains behind the detailed planning was Lieutenant Colonel C L Richardson, the GSO 1 Plans. The implementers were 'A' Force, a special deception unit in GHQ MELF in Cairo, the two Corps in the line and X Corps, the formation designated to exploit the breakthrough. The props were provided by 85 Camouflage Company, base workshops, pioneers and local labour, who combined to construct quantities of dummy vehicles, guns and equipment. A huge amount of RASC transport was required to deliver the goods to the sites.

Disinformation

'A' Force fed false information into the German and Italian espionage networks known to be operating in Cairo and throughout the Middle East. Rumours were leaked from the British Embassy in Cairo and from R G Casey, the Australian who was Churchill's Minister of State in Egypt, that Montgomery's attack was scheduled for a moonless night on 6/7 November. Further disinformation was put about that the new Shermans arriving in the Middle East were suffering from technical desertization troubles and would not be fit for service until November. A bogus conference was arranged for 26 October in Teheran to be attended by Alexander, CinC MELF, Wilson from the Persia and Iraq Command, Wavell, CinC India and Air Marshal Tedder from the UK. The officers and their ADCs were just a little indiscreet in booking air passages and accommodation. Some well publicised cocktail parties and Nile boat trips were organized for late October.

The Southern Bait

In the desert, concealment was virtually impossible and reliance had to be placed on disguise and deception. During September and the first half of October, X Corps's 1st and 10th Armoured Divisions and 24th Armoured Brigade were badly in need of training on a formation, all arms basis to correct the deficiencies exposed in earlier battles. These exercises took place in the southern half of the area between the Mediterranean and the Qattara Depression with the accent on movement in a south-westerly direction. Although 8th Armoured Division had been disbanded to make the other armoured divisions up to strength its headquarters was retained in the south to broadcast bogus signals traffic. 7th Armoured Division was also stationed in the south to launch a holding attack.

A water pipeline already ran from El Imayid railway station near the coast SSE to the Alam el Khadim area. A dummy pipeline, codenamed *Diamond*, was laid in a SSW direction to Samaket Gaballa, 20 miles further on, at a rate which gave the impression of a completion date still nearer the southern sector of early November. Stretches of trench were dug at the rate of four or five miles a day and lengths of dummy pipeline, made from the leaky old four gallon petrol cans, were laid alongside it. At night the trench would be filled in and the dummy pipelines carried forward to the next stretch.

A few miles to the east of Samaket Gaballa a nine mile square patch of desert, codenamed *Brian* was made to look like a dump containing 9,000 tons of combat and engineer supplies by building 700 dummy stacks. One of the armoured exercises in the southern area caused the builders some concern but left a realistic pattern of wheel and track marks. Work on *Brian* started on 7 October and finished a fortnight later.

The Northern Hoax

During the night of 18/19 October and the following day, X Corps concentrated its armoured formations quite openly in three staging areas, *Murrayfield North* and *South*, and *Melting Pot*. They looked like any concentration area for an exercise but were carefully located where the track patterns ran in a south-westerly direction towards the southern sector.

The real assembly area for X Corps, *Martello*, was to be further forward in the northern sector within an easy 15 to 20 miles of the intended point of attack. There could be no hope of hiding such a concentration in an area 12 miles by 8 and so it was decided to establish a pattern, over three weeks in advance of D-Day, which Axis reconnaissance aircraft and intelligence would get used to and accept as something not out of the ordinary. Transport from base and LofC units was brought in to the area and dummies added to bring the total number of vehicles or substitutes to equal the total in X Corps.

Two years earlier, Wavell had suggested the manufacture of quickly detachable wheeled vehicle dummies which could be used to disguise tanks. 722 *Sunshields*, as they were nicknamed, were delivered to *Martello* where they were placed in the precise positions to be occupied by X Corps's tanks. Each hide was given a serial number which corresponded with the serial number given to an individual tank crew. The crews were sent up to *Martello* in trucks which appeared to be part of the normal maintenance traffic and shown where to go when they moved up on the two nights before D-Day, 20/21 and 21/22 October.

A number of tracks had to be constructed between the staging areas and *Martello* to allow X Corps's night moves forward to go without a hitch. The problem was that the tracks would give away the direction of Montgomery's thrust near the coast. The solution was to plan the routes from a combination of ground reconnaissance and air photography to choose terrain where engineer work would be least conspicuous. Having decided on the lines the tracks were to take the engineers began work at different, and to start with, apparently unrelated sections of the track. Only when the sections were joined up just before D-Day was the pattern clear. Then reliance was placed on intercepting enemy reconnaissance aircraft.

The move went without a hitch. As the tanks and trucks left the *Murrayfield* and *Melting Pot*

staging areas, dummies replaced them to present Axis air reconnaissance with a consistent picture. Similarly, the vehicles which had been sitting in the *Martello* assembly area for three weeks were withdrawn as X Corps's trucks took their place. Even the resources of the base workshops could not cope with making the vast number of tank dummies to replace the real tanks as they left the staging areas. Egyptian fellahin in the Fayoum oasis, who make the traditional hurdles for beds and packing cases, were set to work and an ingenious officer worked out how to assemble them with thread and hessian and paint them to look like passable dummies.

Hiding the Artillery and a Double Bluff

Concealing the 400 field and medium guns concentrated in assembly areas behind the front and in their eventual gun positions was solved by erecting a dummy canopy over the 'quad' gun-towers, which had a distinctive shape, and their 25 pounders and limbers. Gun and limber were backed up together with the limber's pole overlapping the gun's trail to produce the pattern of a four wheel vehicle. The dummy canvas tops, called a *Cannibal*, because it swallowed the real equipment, completed the disguise. The assembly areas and the gun position areas were accordingly dubbed *Cannibal 1* and *Cannibal 2*. The disguise was only thrown off after dark on the night of the attack.

In the centre and southern sectors dummy artillery, camouflaged well enough to disguise its bogus nature, was set up to compensate for the artillery concealed by *Cannibals* in the north. In the Munassib Depression a double bluff was organised to support 7th Armoured Division's holding attack and Headquarters, 8th Armoured Division's simulated attack to prevent 21st Panzer and Ariete from reinforcing the sector in the north where the real blow was to fall. Three and a half field regiment's worth of dummy guns and vehicles were set up in *Munassib*. A special effort was made to give a good imitation of normal activity and not to make the camouflage too perfect. A few days before the attack, the camouflage maintenance was allowed to lapse so that Axis air reconnaissance would discover their true nature. At the last minute the dummies were replaced by real guns to support 7th Armoured Division's holding attack. Although the attack was held up after penetrating the screen and the first Axis minefield the surprise added to the credibility of the feint.

Hiding the Supply Dumps

Then there was the task of concealing 6,000 tons of combat supplies in two large dumps, one at El Alamein Station and the other near El Imayid Station 15 miles to the east. At El Alamein the problem was how to hide the main petrol dump. Fortunately the area had been prepared for defence with well constructed, stone-revetted trenches. A layer of petrol cans was stacked up against each wall of a trench so that the internal shadows looked virtually unchanged from the air. The RAF was invited to look for the hidden cache and satisfyingly failed to do so.

Rations were stacked in piles shaped like 3-ton trucks and camouflaged at the standard 150 yard spacing between vehicles. Small quantities of stores were disguised to look like bivouacs. Traffic was deliberately diverted through the dumps to simulate realistic activity. The problem of theft was solved by stowing the attractive items like cigarettes, milk, sugar and tea in the centre of each stack, with less attractive supplies forming the outside layers.

An Assessment

Bertram was the largest and most successful battlefield deception plan executed by the British Army up to that date. In scale it was only surpassed by the elaborate *Fortitude* plan to divert German attention from the Normandy beaches to the Pas de Calais nearly two years later. Prisoners and captured documents showed how well it succeeded. When von Thoma, the new commander of the DAK, was taken prisoner he told his captors that he expected the axis for the attack would develop from the Munassib Depression in the south where large-scale vehicle movements were believed to have taken place. The concentrations in the north had escaped their notice. Panzerarmee intelligence thought that three British armoured divisions were assembling in the southern sector. For four vital days 21st Panzer and Ariete Armoured Divisions were held back in the south. A classic model of deception at the operational level, Operation *Bertram* made a major contribution to the victory at El Alamein.

SECTION 6 - SOME VIEWS ON DESERT WARFARE

GENERAL ROMMEL'S 'RULES OF DESERT WARFARE'

'Of all theatres of operations, it was probably in North Africa that the war took on its most advanced form. The protagonists on both sides were fully motorised formations, for whose employment the flat and obstruction-free desert offered hitherto undreamed-of possibilities. It was the only theatre where the principles of motorised and tank warfare, as they had been taught theoretically before the war, could be applied to the full - and further developed. It was the only theatre where the pure tank battle between major formations was fought. Even though the struggle may have occasionally hardened into static warfare, it remained - at any rate, in its most important stages (ie in 1941-42 during the Cunningham-Ritchie offensive, and in the summer of 1942 - Marmarica battles, capture of Tobruk) - based on the principle of complete mobility.

'In military practice, this was entirely new, for our offensives in Poland and the West had been against opponents who, in all their operations had still had to take account of their non-motorised infantry divisions and had thus had to suffer the disastrous limitation in their freedom of tactical decision which this imposes, especially in retreat. Often they had been forced into actions quite unsuited to the object of holding up our advance. After our breakthrough in France, the enemy infantry divisions had simply been overrun and outflanked by our motorised forces. Once this had happened they had had no choice but to allow their operational reserves to be worn away by our assault groups, often in tactically unfavourable positions, in an endeavour to gain time for the retreat of their infantry.

'Non-motorised infantry divisions are only of value against a motorised and armoured enemy when occupying prepared positions. If these positions are pierced or outflanked, a withdrawal will leave them helpless victims of the motorised enemy, with nothing else to do but hold on in their positions to the last round. They cause terrible difficulties in a general retreat - for, as I have indicated one has to commit one's motorised formations merely to gain time for them. I was forced to go through this myself during the Axis retreat from Cyrenaica in the winter of 1941-42, when the whole of the Italian infantry and a considerable part of the German, including the majority of what was to become 90th Light Division, were without vehicles and had either to be carried by a shuttle service of lorries, or to march. It was only the gallantry of my armour that enabled the retreat of the Italo-German infantry to be covered, for our fully motorised enemy was in hot pursuit. Similarly, Graziani's failure can be attributed mainly to the fact that the greater part of the Italian Army was delivered up helpless and non-motorised in the open desert to the weaker but fully motorised British formations, while the Italian motorised forces, although too weak to oppose the British successfully, were nevertheless compelled to accept battle and allow themselves to be destroyed in defence of the infantry.

'The British forces - in contrast to ours - were all fully mobile, and the war in Africa was, in fact, waged almost exclusively by mobile forces. Out of this pure motorised warfare, certain principles were established, principles fundamentally different from those applying in other theatres. These principles will become the standard for the future, in which the fully-motorised formation will be dominant.

'The envelopment of a fully-motorised enemy in the flat and good-driving terrain of the desert has the following results:

(a) For a fully-motorised formation, encirclement is the worst tactical situation imaginable, since hostile fire can be brought to bear on it from all sides; even envelopment on only three sides is a tactically untenable situation.

(b) The enemy becomes forced, because of the bad tactical situation in which the encirclement has placed him, to evacuate the area he is holding.

‘The encirclement of the enemy and his subsequent destruction in the pocket can seldom be the direct aim of an operation; more often it is only indirect, for any fully-motorised force whose organisational structure remains intact will normally and in suitable country be able to break out at will through an improvised defensive ring. Thanks to his motorisation, the commander of the encircled force is in a position to concentrate his weight unexpectedly against any likely point in the ring and burst through it. This fact was repeatedly demonstrated in the desert.

‘It follows therefore that an encircled enemy force can only be destroyed

(a) when it is non-motorised or has been rendered immobile by lack of petrol, or when it includes non-mobile elements which have to be considered;

(b) when it is badly led or its command has decided to sacrifice one formation in order to save another;

(c) when its fighting strength has already been broken, and disintegration and disorganisation have set in.

‘Except for cases (a) and (b), which occurred very frequently in other theatres of war, encirclement of the enemy and his subsequent destruction in the pocket can only be attempted if he has first been so heavily battered in open battle that the organic cohesion of his force has been destroyed. I shall term all actions which have as their aim the wearing down of the enemy’s power of resistance “battles of attrition.” In motorised warfare, material attrition and the destruction of the organic cohesion of the opposing army must be the immediate aim of all planning.

‘Tactically, the battle of attrition is fought with the highest possible degree of mobility. The following points require particular attention:

(a) The main endeavour should be to concentrate one’s own forces in space and time, while at the same time seeking to split the enemy forces spatially and destroy them at different times.

(b) Supply lines are particularly sensitive, since all petrol and ammunition, indispensable requirements for the battle, must pass along them. Hence, everything possible must be done to protect one’s own supply lines and to upset, or better still, cut the enemy’s. Operations in the enemy’s supply area will lead immediately to his breaking off the battle elsewhere, since, as I have indicated, supplies are the fundamental premise of the battle and must be given priority of protection.

(c) The armour is the core of the motorised army. Everything turns on it, and other formations are mere auxiliaries. The war of attrition against the enemy armour must therefore be waged as far as possible by the tank destruction units. One's own armour should only be used to deal the final blow.

(d) Reconnaissance reports must reach the commander in the shortest possible time; he must take his decisions immediately and put them into effect as fast as he can. Speed of reaction decides the battle. Commanders of motorised forces must therefore operate as near as possible to their troops, and must have the closest possible signal communication with them.

(e) Speed of movement and the organisational cohesion of one's own forces are decisive factors and require particular attention. Any sign of dislocation must be dealt with as quickly as possible by reorganisation.

(f) Concealment of intentions is of the utmost importance in order to provide surprise for one's own operations and thus make it possible to exploit the time taken by the enemy command to react. Deception measures of all kinds should be encouraged, if only to make the enemy commander uncertain and cause him to hesitate and hold back.

(g) Once the enemy has been thoroughly beaten up, success can be exploited by attempting to overrun and destroy major parts of his disorganised formations. Here again, speed is everything. The enemy must never be allowed time to reorganise. Lightning regrouping for the pursuit and reorganisation of supplies for the pursuing forces are essential.

'Concerning the technical and organisational aspect of desert warfare, particular regard must be paid to the following points:

(a) The prime requirements in the tank are manoeuvrability, speed and a long-range gun - for the side with the bigger gun has the longer arm and can be the first to engage the enemy. Weight of armour cannot make up for lack of gun-power, as it can only be provided at the expense of manoeuvrability and speed, both of which are indispensable tactical requirements.

(b) The artillery must have great range and must, above all, be capable of great mobility and of carrying with it ammunition in large quantities.

(c) The infantry serves only to occupy and hold positions designed either to prevent the enemy from particular operations, or to force him into other ones. Once this object has been achieved, the infantry must be able to get away quickly for employment elsewhere. It must therefore be mobile and be equipped to enable it rapidly to take up defence positions in the open at tactically important points on the battlefield.

'It is my experience that bold decisions give the best promise of success. But one must differentiate between strategical or tactical boldness and a military gamble. A bold operation is one in which success is not a certainty but which in case of failure leaves one with sufficient forces in hand to cope with whatever situation may arise. A gamble, on the

other hand, is an operation which can lead either to victory or to the complete destruction of one's force. Situations can arise where even a gamble may be justified - as, for instance, when in the normal course of events defeat is merely a matter of time, when the gaining of time is therefore pointless and the only chance lies in an operation of great risk.

'The only occasion when a commander can calculate the course of a battle in advance is when his forces are so superior that victory is a foregone conclusion; then the problem is no longer one of "the means" but only of "the method". But even in this situation, I still think it is better to operate on the grand scale rather than to creep about the battlefield anxiously taking all possible security measures against every conceivable enemy move.

'Normally, there is no ideal solution to military problems; every course has its advantages and disadvantages. One must select that which seems best from the most varied aspects and then pursue it resolutely and accept the consequences. Any compromise is bad.'

'Rommel's view of the part to be played by heavy anti-aircraft artillery in operations comes out admirably in his order 2640/42 *Secret*, on the *Operational role and chain of command of German Fla and Flak formations*, issued on 16 April 1942 during the reorganization after Crusader.

'Two *Flakabteilungen* were to be placed permanently under command of *DAK* and kept "available for ground operations. This ground role will always have priority over the anti-aircraft role when large-scale operations are undertaken." The anti-aircraft artillery was normally under command of the *Luftwaffe*, but Rommel disposed of Field-Marshal Kesselring, *Oberbefehlshaber Süd*, by the simple process of ordering that, "The Commander of *Flakregiment 135* will co-ordinate the operations of all German *Fla* and *Flak* formations in respect of anti-aircraft employment in accordance with the orders of PzAOK [*Panzerarmee Oberkommando: Supreme Command Panzer Army*]. He will issue the necessary orders on behalf of the *AOK (Ia/Flak)*. Any correspondence arising herefrom will be restricted to essentials. The operations of Italian *Flak* formations will be controlled by the Commander of the Italian Army Artillery, Nicolini."

'The Commander of *Flakregiment 135* was also entrusted with the training of all *Fla* units throughout the area under Rommel's command.'

COLONEL KRIEBEL'S VIEWS ON TRAINING¹

'The operational lull during summer and autumn 1941 was used by the German divisions for preparations of all sorts and for intensive training.... The panzer divisions applied the lessons of the spring to bring their training in mobile warfare up to the desired standard. During the summer and during the autumn battle the divisions, more particularly 15th Panzer Division, had developed *battle tactics of an entirely new kind*.

1. During the interval between the *Battleaxe* and *Crusader* operations, the Germans devoted considerable time to the problem of tactical training. Colonel Rainer Kriebel, 1a, or Chief of Operations, 15th Panzer Division, contributed an article to *Der Feldzug in Nordafrika 1941-43*, edited by W Nehring, which was reproduced in J A I Agar-Hamilton and L C F Turner, *The Sidi Rezegh Battles, 1941*, Oxford, Cape Town 1957, pages 56-58. The italics are Colonel Kriebel's.

In order to understand the operations between November 1941 and February 1942 it is essential to understand these new tactics. Unlike the European war theatre, the desert terrain permitted the use, almost everywhere, of vehicles of every imaginable kind. In the desert it was not necessary for large formations to move in columns which would then, when the necessity arose, proceed to take up battle formations with all the consequent delay. It was advisable to move in the kind of formation which would enable the full strength of a division to be brought to bear immediately. Where there were no roads to justify movement in columns at high speed, the divisions moved in *Flaechenmarsch* ['plain-formation'], with the battle groups one behind the other, and in such a move the depth of each battle group was no more than about four times its width.

'In desert warfare, operations against armoured units were more frequent than operations against entrenched infantry. It was therefore advisable to have the most important arm of the division, i.e. the panzer regiment, supported by all other units of the division, even if it was a question of operations against enemy armour. Tactics of this kind had thus far been customary only in operations against mixed formations of all weapons.

'The most important support weapon was the *heavy anti-aircraft battery* of 8.8 cm. guns, which were able to penetrate the armour of the enemy's heavy tanks at exceptionally long range. When the division was on the move, therefore, the guns were placed in the march column of the panzer regiment. These 8.8 cm. guns, together with elements of the panzer regiment, engaged the enemy armoured formations, while the main body of the panzer regiment approached the enemy armour at top speed until they had brought their guns or their tanks within range.

'Motorized artillery also proved a very valuable supporting weapon for armoured operations. It was the task of the motorized artillery to provide fire protection for their own armour as it attacked, to hold down enemy anti-tank artillery and armoured artillery observers, and also to lend flanking protection to the attacking forces by their fire. It became evident that enemy tanks were extremely vulnerable to concentric artillery fire. It was frequently possible to disperse a concentration of enemy tanks which had been assembled for the attack, or at least to delay attack. For this purpose the artillery in question moved dispersed at intervals through the panzer regiment. The armoured artillery observation vehicles travelled with the leading tanks. The staffs of artillery units usually travelled with the commanders of the armoured units. With the rear battle groups of the division on the move there was usually only one artillery unit which was responsible for flank protection.

'The artillery soon learned to take up positions and open fire so rapidly that the tank attack suffered practically no delay at all.

'It very soon became clear that enemy armoured formations frequently avoided the attack of a well-led and powerful German panzer division.

'Taking advantage of the higher speed of their tanks they tried to bring their armour to bear against the unprotected flanks and rear of the panzer division. Hence the *Panzerjaegerabteilung* [tank-destroyer group] was charged with covering the flank of the division most open to enemy attacks, and also with anti-tank operations in the vicinity of the soft-skinned parts of the division. There were, however, occasions when the tank-destroyer groups were used in pursuit, and also to strengthen and broaden the attack of their own armour.'

SECTION 7 - OPERATION DESERT STORM

(Some Early Thoughts by Colonel Sellers RO1 Author 1991)

It is likely that the intelligence staffs overestimated both the strength and capabilities of the Iraqi forces. Divisions are assumed to be at their war establishment. The effective strength of the Iraqi Army in the Kuwait Theatre of Operations was probably nearer 260,000 than 500,000 at the beginning of the air campaign, reducing by death, wounds and desertion during the five-and-a-half weeks of the air preparation to a figure nearer 200,000 by G Day on 24 February. The Republican Guard had a reputation like Napoleon's Guard or the Waffen-SS but they had acquired this reputation against Iranian troops who were not well trained. The Republican Guard had expanded far too quickly for its own good so that its exaggerated efficiency was eroded still further. However, some of its units did stand to fight it out with inferior weapon systems.

It was probably no bad thing that the Iraqi capability and strength were overestimated. At least a Coalition force sufficiently large, well trained and equipped to guarantee a quick and cheap victory was despatched to the Gulf in time to gain a decision before Ramadan and the hot weather. Using a sledgehammer to crack a nut is better than sending a lad on a man's errand, a fault of which we have too often been guilty in the past. The Americans were haunted by Vietnam. They had to make sure of rapid success for the sake of their armed forces, their people at home and world opinion. The 38 day air campaign and the 100 hour war laid the ghosts of Vietnam.

The Coalition forces, especially the American and British, had vastly superior equipment to the Iraqis. The latter's T-72 was only marginally better than the US Marine's M-60 but no match at all for the M1A1 Abrams and the Challenger with their excellent night and bad weather visual equipment for commander, gunner and driver. However, most of the Iraqi tanks were ancient T-54/55s. The Iraqi artillery was good but without night and bad weather observation aids it could not bring its shells down in the right place.

The Coalition air forces and attack helicopters were superior to anything the Iraqis had and were soon able to establish not just air superiority but air supremacy. The main benefits were that the Iraqi's mobility on the battlefield was severely limited, Iraqi intelligence was deprived of its eyes, the army's supply system was interdicted, especially by the destruction of most of the bridges over the Euphrates, a feat which took a tremendous effort in the Second World War with only 'iron bombs'. By the time the ground war started the Iraqi air force had been neutralized and the fighting capacity of its army degraded. It is interesting to note that the Coalition artillery, tube or MLRS, proved more destructive on the battlefield than air weapons.

Schwarzkopf's solution of the command problem was a *tour de force*. Making Khalid a partner in command satisfied the *amour propre* of the Arab rulers, generals and troops. It was also the most efficient way of controlling and issuing orders to so many nationalities. Schwarzkopf played his first among equals role with great tact and understanding.

The allocation of formations to tasks was handled to perfection. The solid hitting power of VII Corps was concentrated round the American armoured, mechanized and cavalry divisions to which the British were able to make a magnificent contribution in the shape of

the 1st (BR) Armoured Division. These formations understood and could apply the principles of the AirLand battle, moving fast and fighting in three dimensions, their helicopters working in partnership with their armour. Perhaps the Corps was unlucky not to have a Wade Hampton or a Phil Sheridan to direct it.

In XVIII Corps the French 6th Light Armoured Division was ideally suited to its flank protection role. The 101st Air Assault Division had the mobility and massive attack helicopter air power to interdict the Euphrates valley. The 24th (US) Infantry Division (Mechanized) gave the Corps a heavy punch and was eventually used to reinforce VII Corps for the battle against the Republican Guard. The US (Marines) were ideal for the dogged battle through the main belt of Iraqi fixed defences and provided confident support for the JFCs on either flank. The JFCs were well grouped from the point of view of operational compatibility and given tasks within the capability of such mixed forces. The Egyptian Corps was professional, painstaking and thorough. It reminded one of those British divisions in the Second World War which habitually lived in minefields from El Alamein onwards. The Egyptians already had some experience of their *Desert Storm* role in the attack on the Bar Lev Line in 1973.

Air supremacy made possible Schwarzkopf's 'Hail Mary' concept for the battle, except that it was not the quarter-back's desperate last minute effort to snatch victory from the jaws of defeat but a carefully thought out gambit. Because the Iraqi Army was immobilized by the Coalition air forces and had no concept similar to the AirLand battle philosophy its commanders had no way in which they could interfere with the Coalition's operations or influence the situation. The Iraqi's slogging matches against the Iranian Army were no preparation for a war of manoeuvre.

The other factor which made the Coalition victory possible was its logisticians' competence. Everyone from Lieutenant General Pagonis at the upper end of the command scale to Colonel Martin White, who managed the British division's logistic effort, performed outstandingly. In a desert environment it was perhaps wise to overinsure and to bring in ammunition and fuel for a possible 60 day campaign.

From the mechanical engineer's point of view the fine dust of the Iraqi desert makes special filters essential. Sand erodes helicopter blades but tape reduces the rate of erosion.

The weather was not kind. Winters in Middle Eastern deserts are often bitterly cold and wet. The Shamal blows rain and sand with a stinging ferocity to everyone's intense discomfort. It reduces visibility, although thermal imagers can see through it better than the human eye. In areas of soft sand the bottom falls out of the desert, seriously reducing mobility. At least the desert on the Iraqi-Kuwaiti border where VII Corps met the Republican Guard was mostly good, hard, firm gravel. Further inland the French had to cope with some very rough shale, which is as unkind to tyres, track rods and suspensions as it is to passengers. Skilful driving, which involves knowing how to tackle everything from low rocky ledges to soft sand, is only acquired through training and experience in the environment.

From the navigator's point of view the introduction of GPS was a revolution in the art of finding one's way in the desert and knowing one's precise location. When an enemy is obliging enough to dig an elaborate defensive system which can be photographed and

overprinted on maps the two can be used in conjunction. With so few natural features the British use of metals as code names to identify defensive positions provided a useful plot.

All in all, the campaign was a triumph for Western and Arab diplomacy, allied cooperation, the selection of an attainable but limited aim, sound logistic planning and the high professional standards of well trained regular forces. The West currently enjoys a technological superiority which it was able to apply to great advantage in the empty desert. The conflict, and the preparatory period leading up to it, gave our forces the opportunity to adapt the art of mobile warfare learnt on the training areas of Germany to an environment unfamiliar to many. The experience gained may prove useful at some future date in an unstable world.

Finally, the political background to *Desert Shield* and *Desert Storm* could not have been more favourable. Saddam Hussein's blatant act of aggression placed him beyond the pale in the international forum. The majority of the Arab world was united with the west under UN sponsorship to remove the aggressor from Kuwait. The aim was limited to the liberation of the Sheikdom and no member of the Coalition had any designs on Iraqi territory. Overwhelming force was applied with wisdom; civilians and civilian targets were scrupulously avoided whenever possible. It is unlikely that many future crises in an increasingly polycentric world will be so readily manageable and command so much international support to enable such a satisfactory result to be achieved in so short a time.

SECTION 8 - BIBLIOGRAPHY

1. **General.** A selection of the large number of books published about desert warfare is given in this Section for those who wish to know more about the details of particular campaigns. This is a small fraction of the books available. Other books can be obtained through the Army Library Service which will have a comprehensive list of many other books and authors.

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