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Field Manual
No. 90-3

DESERT OPERATIONS

*This Field Manual supersedes FM 31-25, 29 February 1972; and TC 90-3, 30 September 1975.

The US Army Armor School (USAARMS) is the proponent for this publication. Recommended changes and comments for its improvement are solicited. Prepare comments and recommended changes on DA Form 2028 and forward to Commandant, US Army Armor School, ATTN: ATSB-TD, Fort Knox, KY 40121.

To comply with guidance of the Assistant Secretary of Defense (Manpower and Reserve Affairs), this Field Manual has been reviewed for the use of neutral language. Unless otherwise noted, where the third person singular is used in this publication, the word "he" will be understood to stand for both masculine and feminine genders.

INTRODUCTION

The purpose of this manual is to describe how US Army forces fight in the desert. Conditions will be encountered in the desert that have a profound effect on military operations. Desert operations require, among other things, special equipment, special training and acclimatization, and a high degree of self discipline if operations are to be successful.

Since World War II, warfare has changed, not abruptly, but steadily and rapidly. The range, accuracy, and lethality of the modern tank cannon make it at least five times as effective as the tank gun of World War II. The antitank guided missile has appeared on the battlefield in great numbers and is deadly out to ranges of well in excess of 3,000 meters; even against rapidly moving crossing targets it can achieve 90 percent first round hits. The US Air Force has precision guided munitions, as will US Army helicopters and field artillery in the near future. Helicopters are already equipped with antitank guided missiles and field artillery ammunition is far more lethal than it was in the early 1940's. Weapons are equipped with increasingly effective night sights and a variety of sensor devices are employed to detect forces and equipment on the battlefield.

Although desert terrain may vary from place to place, as a general rule, observation is often excellent while concealment may be difficult. Because of these conditions, modern weapons are normally more effective in the desert than anywhere else. The 1973 war in the Middle East clearly demonstrated that weapons systems not properly utilized will surely be destroyed.

In that war, Arabs and Israelis were armed with the latest weapons, and the conflict approached a destructiveness once attributed only to nuclear arms. Use of aircraft for close support of advancing armor, in the fashion generally practiced since 1940, was greatly reduced by surface-to-air missiles and air defense guns. In clashes of massed armor such as the world had not witnessed for 30 years, both sides sustained devastating losses, approaching 50 percent in less than 2 weeks of combat.

It should be remembered, however, that principles and fundamentals of combat do not change in the desert. Priorities may alter, techniques may vary from those in temperate climates, but a soldier who is fit and well trained to fight in other environments will have little difficulty adjusting to desert war.

OPERATIONAL PHASES

The most likely situation that could involve US forces in desert operations is one in which a country has requested assistance against a mutual enemy operating in or against the country concerned. US Army forces could expect to be initially deployed in a lodgement area that should have an airfield suitable for landing heavy transport aircraft and, ideally, a deep water port. Operations would probably be conducted in four phases, supported as necessary by US naval and air forces:

Establishment of the Lodgement Area. It may be necessary to defend the lodgement area against insurgents, saboteurs, terrorists, or others sympathetic to the enemy. In any event, it will be necessary to secure it in order to establish a logistics base. For this reason, combat forces should be deployed early to allow the buildup to begin.

Buildup of the Logistic Base and Combat Forces. During this phase the logistics base is established to support the force. Follow on combat and combat support forces are brought into the theater, and the lodgement area is expanded as necessary.

Defensive Operations To Secure the Initial Area of Operations. It may be necessary to defend outnumbered until such time as sufficient combat power is available in the operational area to conduct offensive operations.

Offensive Operations To Destroy the Enemy. Offensive operations are conducted once sufficient combat, combat support, and combat service support forces have been deployed into the area to sustain such operations. Normally this time will come when US Army forces and their allies are able to establish at least local ground superiority.

It may be necessary to seize a lodgement area by force by air landing, air assault, or by over the beach operations. When this is the case, the operation is phased in essentially the same manner described above.

READER-USER EFFECTIVENESS

This manual describes how to prepare for desert operations, how units fight in the desert, and how combat service support operations function in such an environment. It is supplemental to other manuals that describe how various organizations fight on the modern battlefield. It does not describe principles and techniques found in other How-to-Fight manuals unless there is a need for emphasis or clarity, or to show variations from these principles or techniques. *Therefore, in order to understand principles set forth in this manual the reader should first be thoroughly familiar with the How-to-Fight manual that addresses his level and type of organization.*

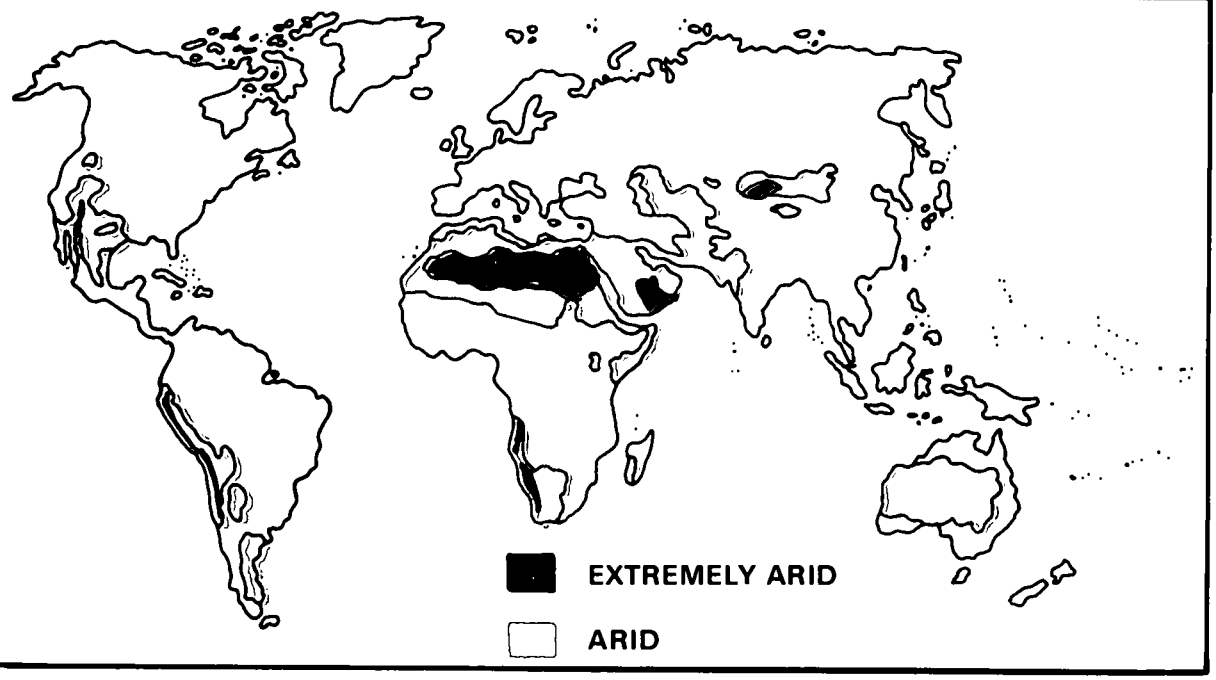
THE ENVIRONMENT AND ITS EFFECTS ON PERSONNEL AND EQUIPMENT

THE ENVIRONMENT

The desert is harsh; living conditions can be extremely uncomfortable; the desert can easily kill an unprepared soldier. The desert can pose a constant challenge to every soldier and each must be physically, mentally, and professionally prepared to meet that challenge. This chapter describes the environment, how the environment affects personnel, and how the environment affects equipment. How the environment affects tactical operations is described in chapter 4.

CONTENTS

DESERT AREAS OF THE WORLD



ENVIRONMENT

In order to prepare for desert operations, to fight in the desert environment, and to provide the combat service support required for successful desert operations, it is first necessary to understand the environment.

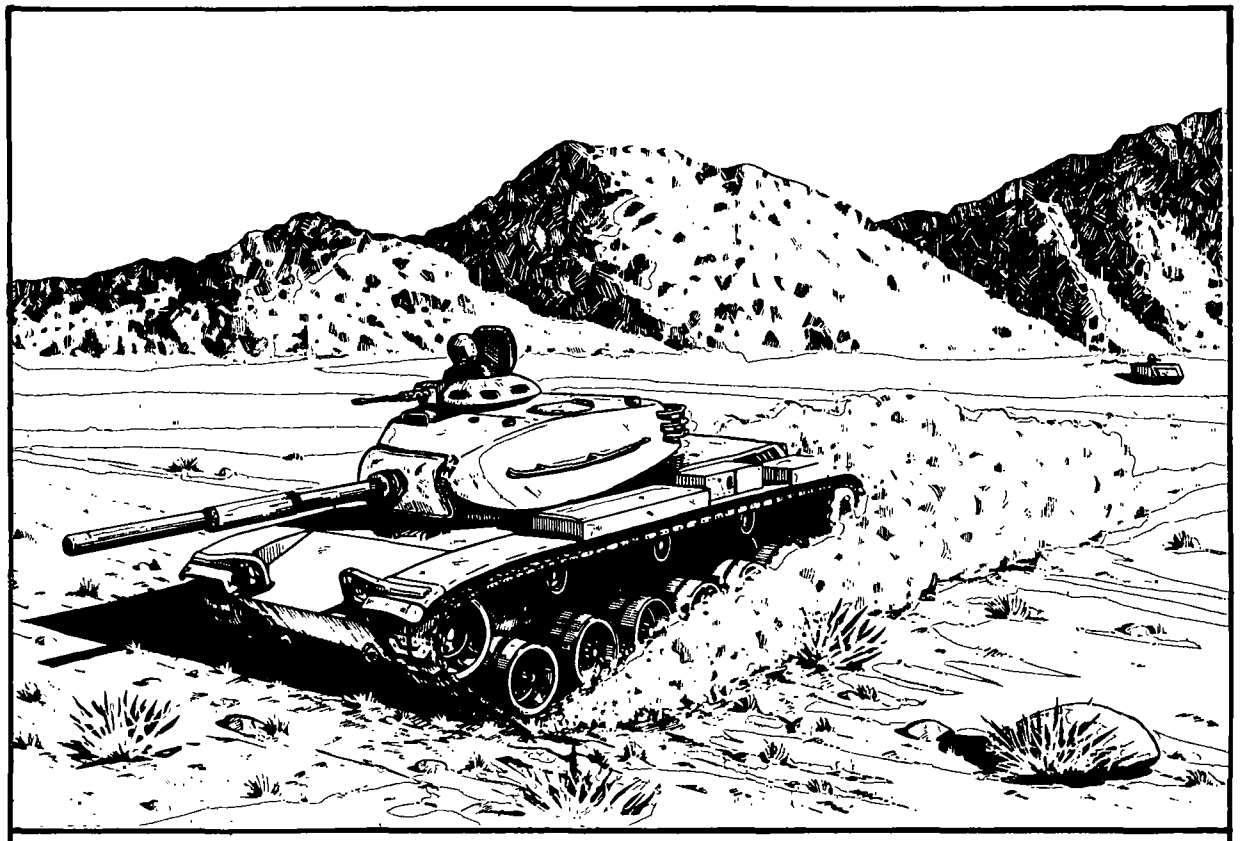
Deserts are arid, barren regions of the earth incapable of supporting normal life due to lack of fresh water. Temperatures vary according to latitude and season, from over 136°F in Mexico and Libya to the bitter cold of winter in the Gobi in East Asia. In some deserts, day to night temperature fluctuation can exceed 70°F. Some species of animal and plant life have adapted successfully to desert conditions where annual rainfall may vary from zero to 10 inches but is often totally unpredictable. Desert terrain also varies considerably from place to place, the sole common denominater being lack of water with its consequent environmental effects, such as little if any prominent vegetation. This environment can profoundly affect military operations.

Desert countries of the Middle East are briefly described and the main deserts of the world are listed in appendix A. It is important to realize that deserts are affected by seasons. Those in the Southern Hemisphere have a summer between 21 December and 21 March. This 6-month difference from the United States is important when considering equipping and training nonacclimatized soldiers for desert operations south of the equator.

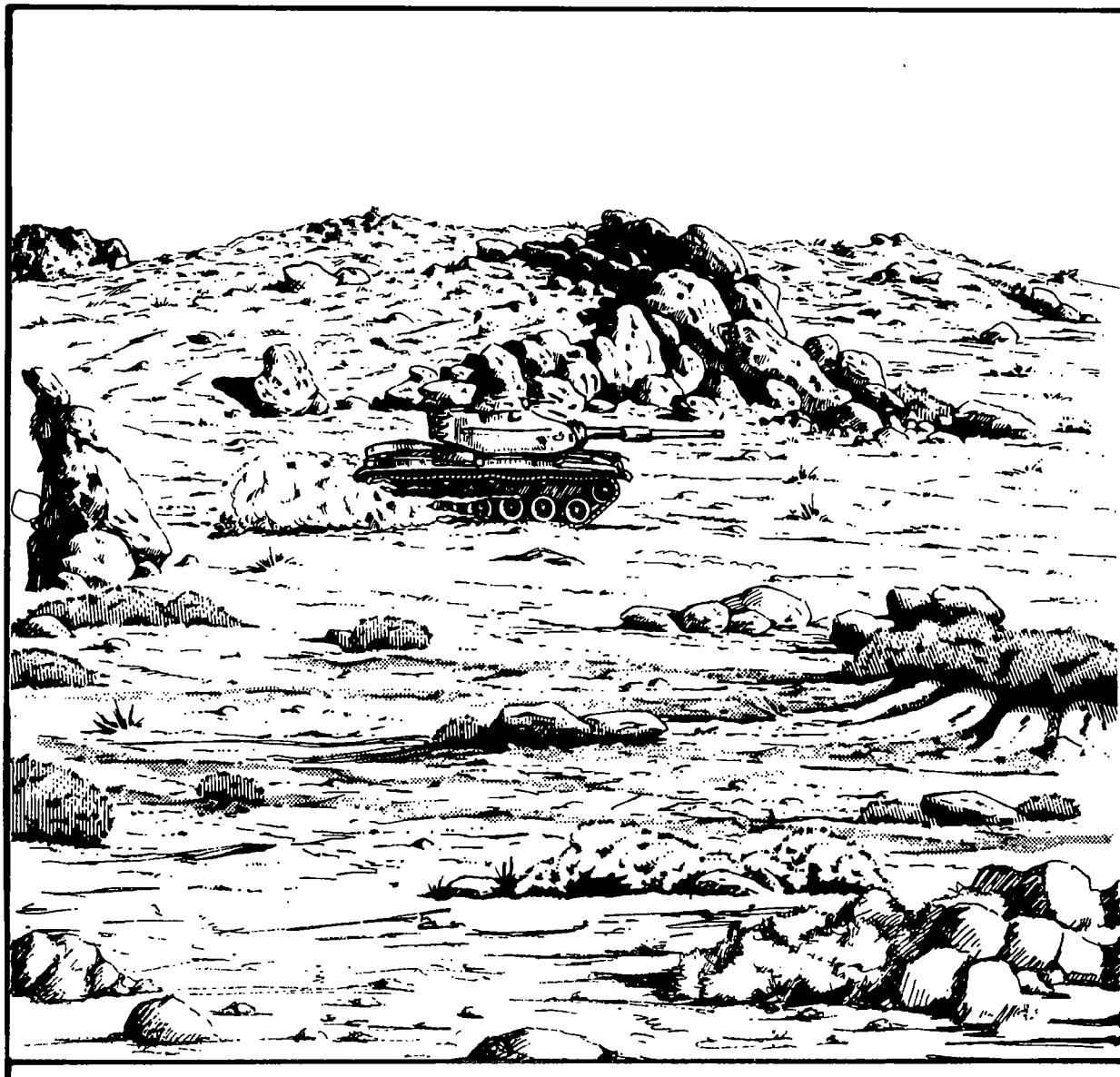
THE TERRAIN

There are three types of deserts: mountain, rocky plateau, and sandy or dune deserts.

Mountain deserts are characterized by scattered ranges or areas of barren hills or mountains, separated by dry, flat basins. High ground may rise gradually or abruptly from flat areas, to a height of several thousand feet above sea level. Most of the infrequent rainfall occurs on high ground and runs off rapidly in the form of flash floods, eroding deep gullies and ravines and depositing sand and gravel around the edges of the basins. Water rapidly evaporates, leaving the land as barren as before; although there may be shortlived vegetation. If sufficient water enters the basin to compensate for the rate of evaporation, shallow lakes may develop, such as the Great Salt Lake in Utah or the Dead Sea; most of these have a high salt content.



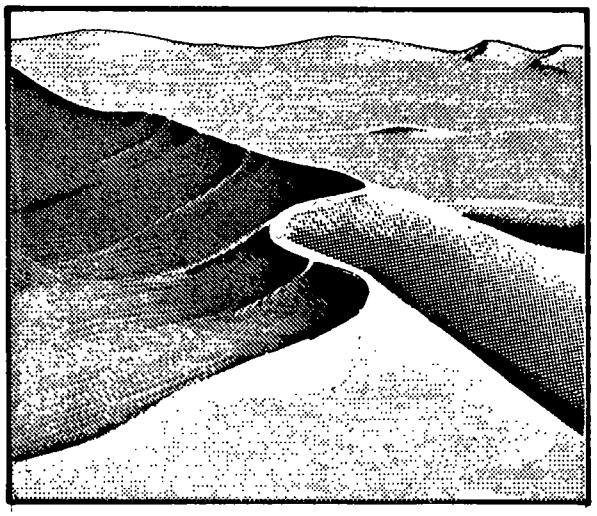
MOUNTAIN DESERT—YEMEN (ADEN)

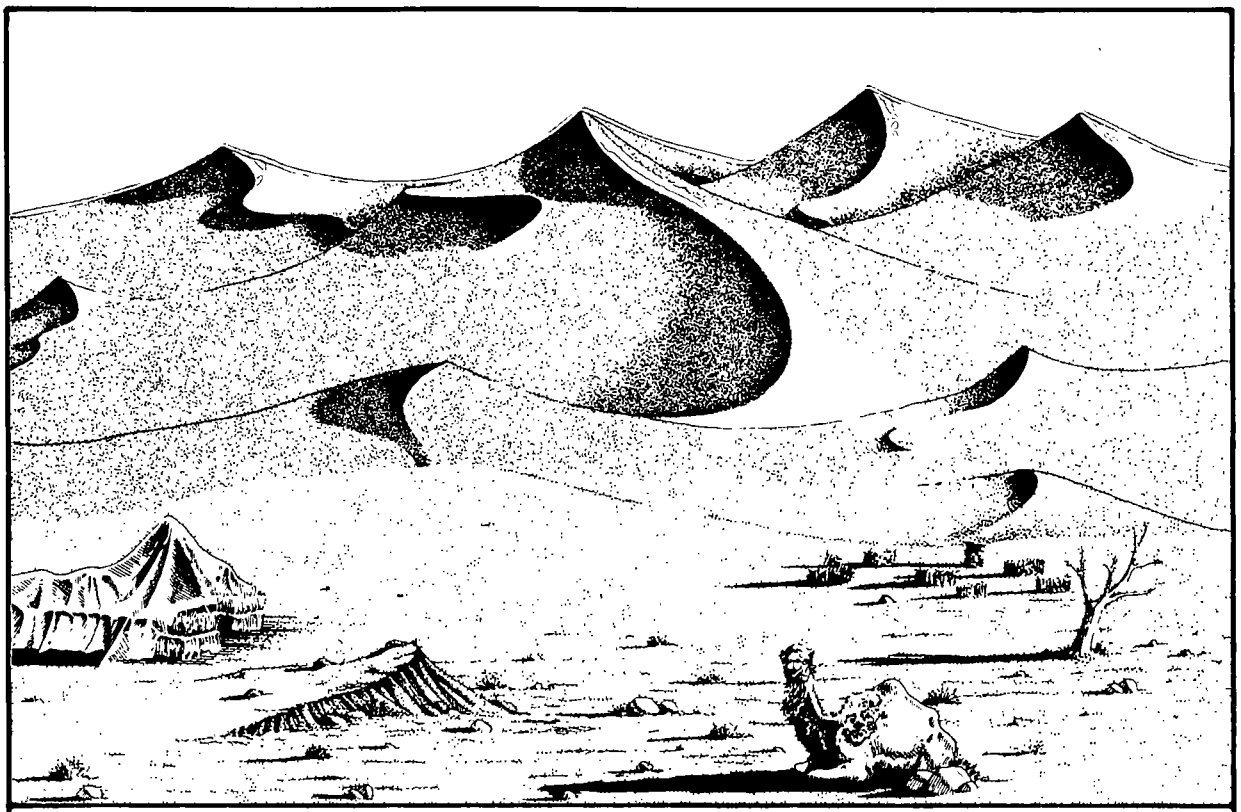


ROCKY PLATEAU DESERT—THE GOLAN HEIGHTS

Rocky plateau deserts have relatively slight relief interspersed by extensive flat areas with quantities of solid or broken rock at or near the surface. They may be cut or dry, steep-walled eroded valleys, known as *wadis* in the Middle East and *arroyos* or *canyons* in the United States and Mexico. The narrower of these valleys can be extremely dangerous to men and materiel due to flash flooding after rains; although their flat bottoms may be superficially attractive as assembly areas. The Golan Heights is an example of rocky plateau desert.

Sandy or dune deserts are extensive flat areas covered with sand or gravel, the product of ancient deposits or modern wind erosion. "Flat" is relative in this case, as some areas may contain sand dunes that are over 1,000 feet high and 10-15 miles long; trafficability in such terrain will depend on windward/leeward gradients of the dunes and texture of sand. Other areas, however, may be totally flat for distances of 3,000 meters and beyond. Plant life may vary from none to scrub reaching over 6 feet high. Examples of this type of desert include the *ergs* of the Sahara, the Empty Quarter of the Arabian Desert, areas of California and New Mexico, and the Kalahari in South Africa.



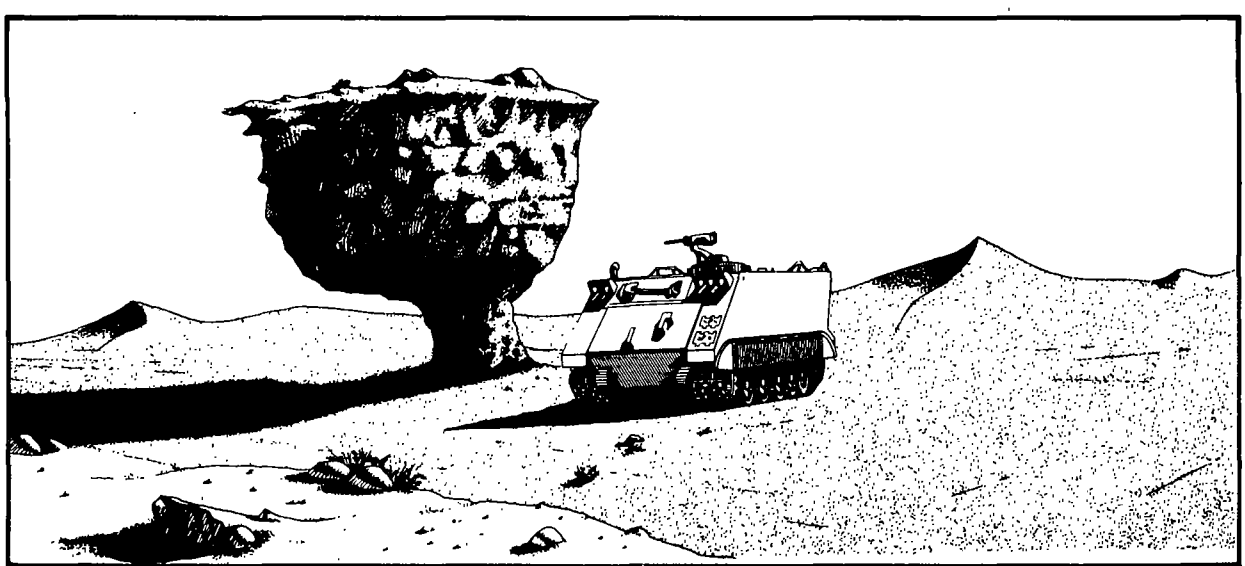


DUNE DESERT—WESTERN SAHARA

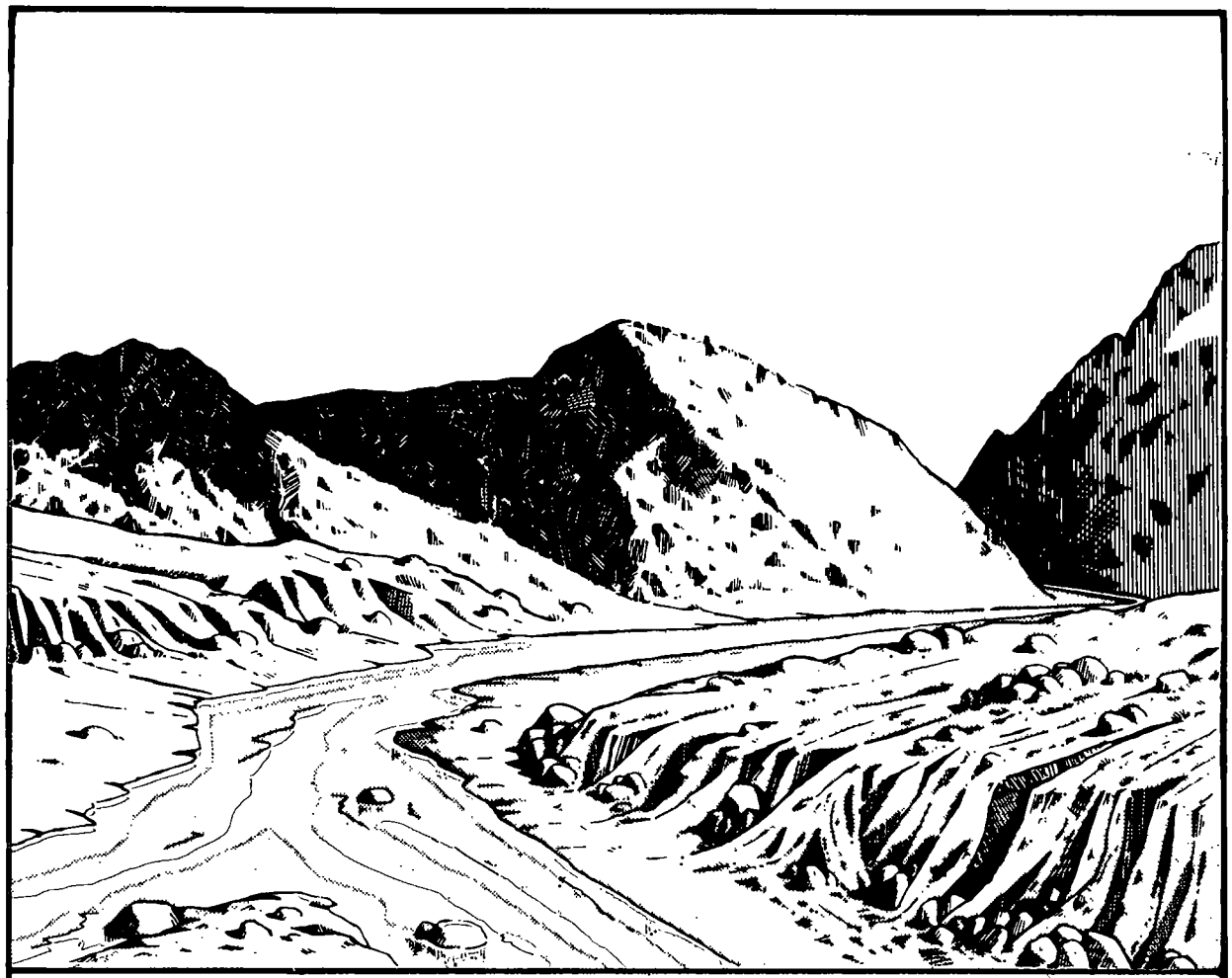
CLIMATE AND WEATHER

Temperatures. The highest known ambient temperature recorded in deserts was 136.4°F (58°C). Lower temperatures than this produced internal tank temperatures approaching 160°F (71°C) in the Sahara Desert during the Second World War. Temperatures during winter in USSR deserts and in the Gobi can reach minus 50°F (45°C). Low temperatures can be aggravated by very strong winds producing high wind chill factors. The cloudless sky of the desert will permit the earth to heat up during sunlit hours, yet cool to near freezing at night. In the inland Sinai, for example, day to night temperature fluctuations can be as much as 72°F imposing an unusual strain on personnel and sometimes affecting equipment.

Winds. Desert winds can achieve almost hurricane force and dust and sand suspended within them can make life almost intolerable, maintenance very difficult, and restrict visibility to a few meters. The Sahara *Khamseen*, for example, can last for days at a time; although it normally only occurs in the spring and summer. The deserts of Iran are equally well-known for the "wind of 120 days," with sand blowing almost constantly from the north at wind velocities of up to 75 miles per hour. Although there is no danger of a man being buried alive by a sandstorm, individuals can become separated from their units. In all deserts, rapid temperature changes invariably follow strong winds.



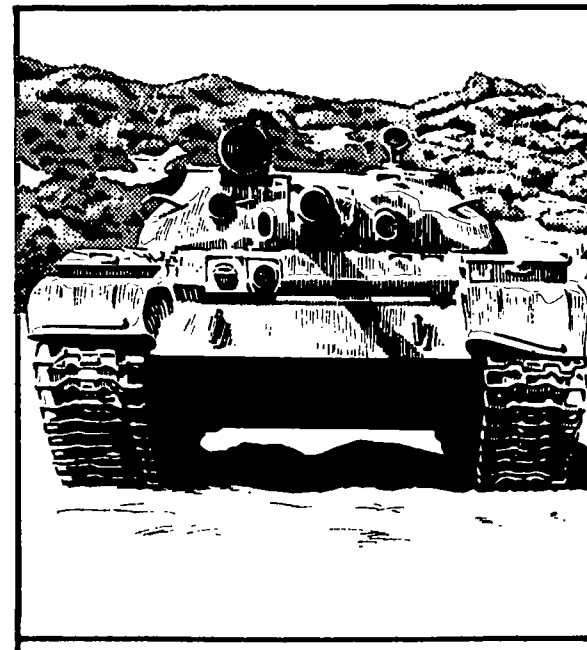
WIND EROSION—SAHARA



WADI AFTER RAINSTORM—SAHARA

Rain. The common characteristic of all deserts is their aridity. No rainfall has been recorded in areas of the Atacama in Chile, for example, for several years, but rain does fall in deserts. Rain, when it occurs, may consist of one single violent storm in a year with high surface water run-off which, depending on soil consistency, will either reduce trafficability in loam of wadi areas or somewhat improve it if the terrain is pure sand. Precipitation may occur in the form of hail even though ground temperature is in the nineties. Rain is usually too much too quickly, and likely to be a liability rather than an asset. Also, rain occurring as much as several hundred miles away can cause flooding in another distant location. Otherwise dry stream beds can suddenly become extremely hazardous as a channel of flooding.

Light. A powerful sun and low cloud density combine to produce unusually bright and glaring light conditions during the day. In certain circumstances, light allows such unlimited visibility that gross underestimation of distance is common. Visibility conditions may, however, be degraded by mirages or heat shimmer (caused by heated air rising from the extremely hot desert surface), especially if the observer is looking into the sun or through magnifying optical instruments. Because mirages distort the shape of objects, particularly in the vertical dimension, observation is best at dawn and dusk when the air is cooler. Positions selected for observation posts should be as high above the desert floor as possible. Vision with night observation devices and even with the naked eye is exceptionally good on moonlit nights.



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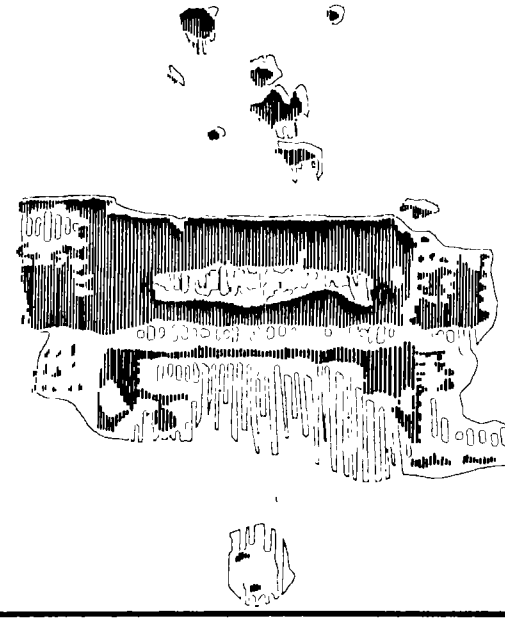
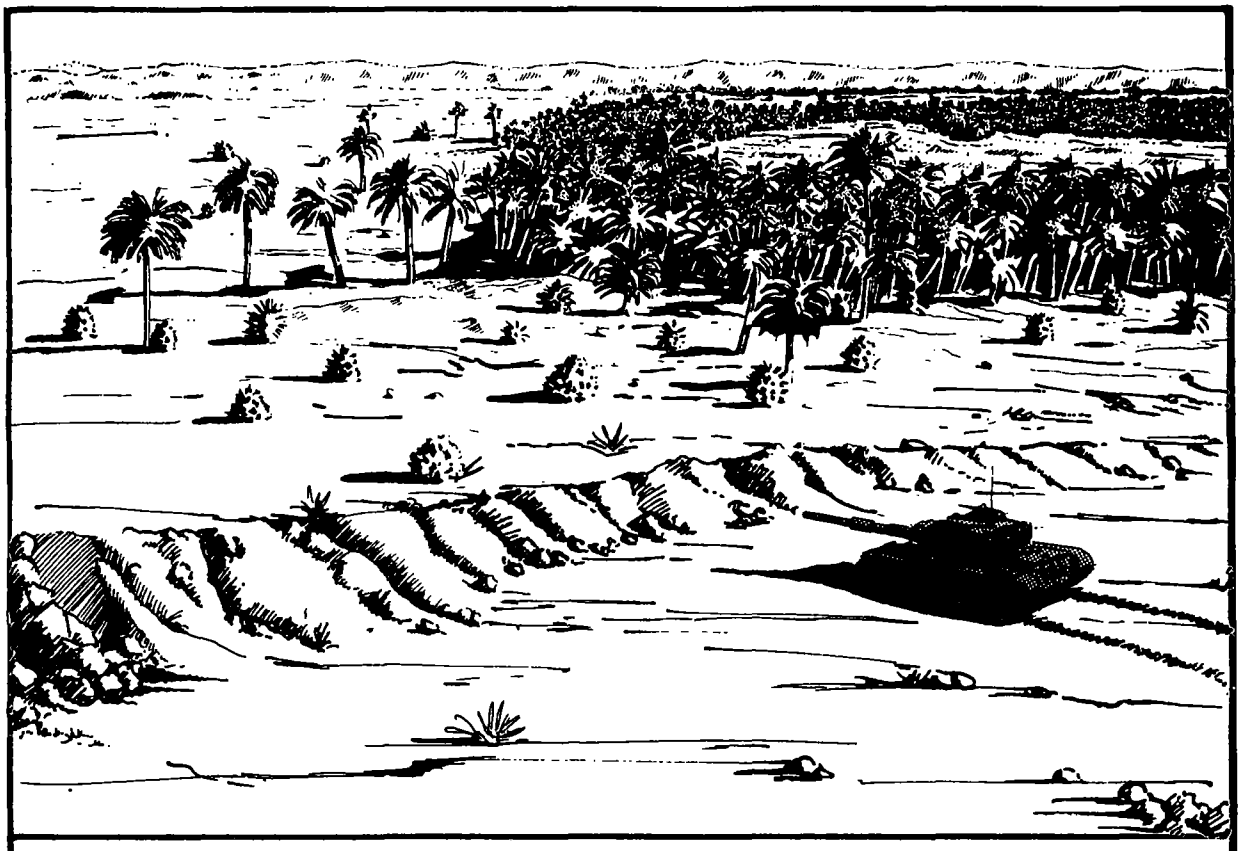


EFFECTS OF MIRAGE



TYPICAL OASIS—EGYPT

WATER

Because the lack of water is the most important single characteristic of the desert, the population if any, varies directly with local water supply. A Sahara oasis may, for its size, be one of the most densely occupied places on earth. Permanent rivers such as the Nile, the Colorado, or the Kuiseb in the Namib Desert of Southwest Africa do exist but are fed by heavy precipitation outside the desert so the river survives despite a high evaporation rate. Ground water in such places as oases and near-surface wells is caused by subsurface seepage from considerable distances, and water drunk in a Sahara oasis may have fallen as rain in the highlands of the south before the time of Christ.

Subsurface water may be so far below the surface, or so limited, that wells are normally inadequate to support any great number of people. Therefore potable water supplies can never be taken for granted; although an adequate, uninterrupted supply must be maintained. Thus, a large natural water supply may be both tactically and strategically important. Destruction of a water supply system may become a matter of political decision, rather than military, because of its lasting effects on the resident civilian population.

VEGETATION AND WILDLIFE

Vegetation. The indigenous vegetation and wildlife of a desert have physiologically adapted to the conditions. Some plants have extensive lateral root systems to take advantage of the occasional rain while others have deep roots to reach subsurface water. For example, a palm tree indicates water within 2 to 3 feet of the surface; salt grass implies that the water table is within 6 feet; cottonwood and willow trees indicate water at a depth of 10-12 feet. Other varieties of plants, such as the cactus of the American desert, bear no relation to the water table since they store moisture in enlarged stems. Some plants have drought-resistant seeds that may lie dormant for years, followed by a brief but colorful display of growth after a rainstorm. The available vegetation is usually inadequate to provide much shade, shelter, or concealment, especially from the air. Lack of natural concealment has been known to induce temporary agoraphobia (fear of open spaces) in some soldiers new to desert conditions, but this fear normally disappears with acclimatization.

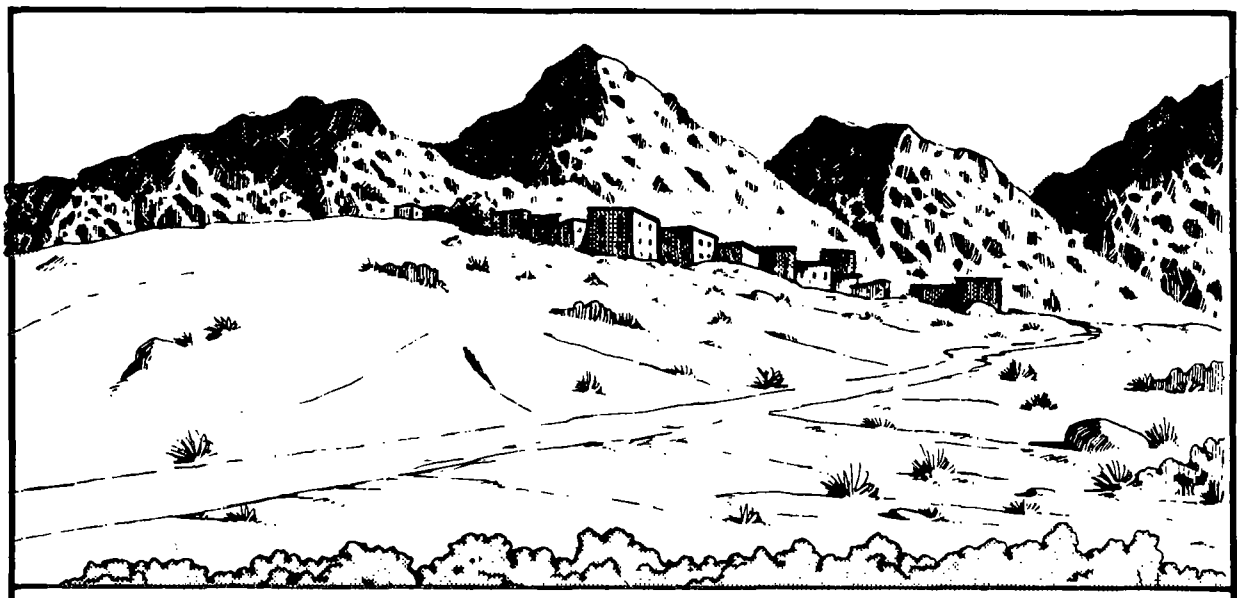
Invertebrates. Invertebrates such as ground-dwelling spiders, scorpions, and centipedes, together with insects of almost every type, are found in quantity in the desert. Drawn to man as a source of moisture or food, lice, mites, and flies can be extremely unpleasant and carry diseases such as scrub typhus and dysentery. The stings of many scorpions and the bites of centipedes or spiders can be extremely painful, though seldom fatal. Some species of scorpion, black widow or recluse spiders, however, can cause death.

Reptiles. Reptiles are perhaps the most characteristic group of desert animals. Lizards and snakes occur in quantity, and crocodiles are common in some desert rivers. Lizards, can normally be disregarded; although exceptions occur in North America and Saudi Arabia. Desert snakes, however, can be extremely dangerous and should be avoided.

Mammals. The camel is the best known variety of specialized mammal life in the desert. Like most desert mammals, the urine of the camel is very concentrated to reduce water loss, allowing it to lose 30 percent of its body weight without undue distress. A proportionate loss would be fatal to man. The camel can regain this weight by drinking up to 27 gallons (120 liters) of water at a time. It cannot, however, continue indefinitely without water and can die of dehydration as easily as man in equivalent circumstances. Other mammals, such as gazelles, obtain all or most of their required water supply from the vegetation they eat and may live in areas where there is no open water. Smaller animals, including rodents, conserve their moisture by burrowing underground away from the direct heat of the sun, only emerging for foraging at night. All these living things have adapted to the environment over a period of thousands of years. Man has not done so and must carry his food and water with him.

MAN-MADE CHARACTERISTICS

Roads and Trails. Roads and trails are scarce in the open desert, as complex road systems beyond simple commercial links are not needed. Some surfaces, such as lava beds or salt marsh, may preclude any form of routine vehicular movement, but ground transportation can often travel in any direction necessary; although speed of movment will vary depending on surface texture. Such road systems that exist have normally been used for centuries to connect centers of commerce, or important religious shrines, such as Mecca and Medina in Saudi Arabia. These road systems are now supplemented by routes joining oil or other mineral deposits to collection outlet points. Rudimentary trails exist in many deserts for use by minor caravans and nomadic tribesmen, with wells or oases approximately every 20 to 40 miles; although there are some waterless stretches of over 100 miles. Trails vary in width from a few meters to over 800 meters. Vehicle travel in mountainous desert country may be severely restricted. Available routes can be easily blocked by the enemy or by climatic conditions. Hairpin turns will be present on the edges of precipitous mountain gorges, and the higher passes may be blocked by snow in the winter. The distances on foot or animal between two points in the mountains may be less than a tenth of the vehicular route.



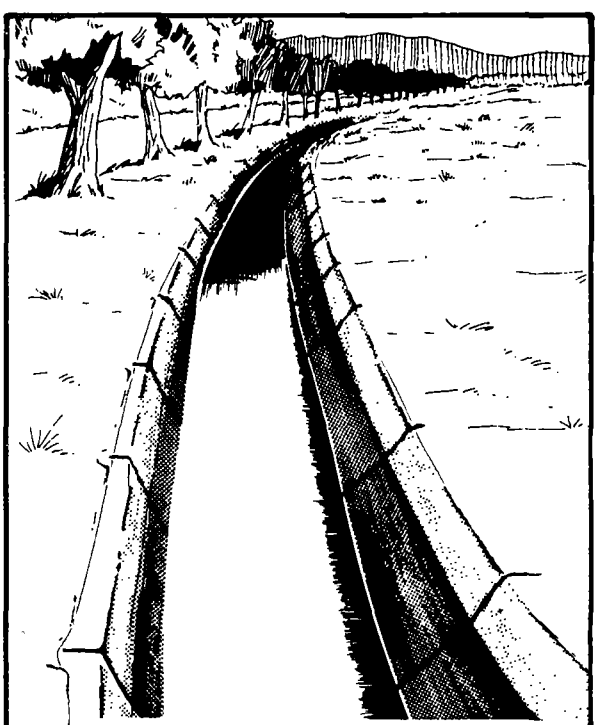
MAN-MADE DESERT STRUCTURES

Structures. Apart from nomadic tribesmen who live in tents, the local inhabitants of deserts live in thick-walled structures with small windows, usually built of masonry or a mud and straw (adobe) mixture. Wood is difficult to find; that available is probably already in use. The ruins of earlier civilizations are scattered across the deserts. Ancient posts and forts, usually in ruins, invariably command important avenues of approach and frequently dominate the only available passes in difficult terrain. Control of these positions may be imperative for any force intending to dominate the immediate area.

DESERT NOMADS

Minerals. Exploration for and exploitation of minerals, of which oil is the best known, occurs in many desert areas, especially in the Middle East. Wells, pipelines, refineries, quarrying and crushing plants may be of strategic and tactical importance. Pipelines are often raised 1 meter off the ground; where this is the case, pipelines can inhibit movement.

Agriculture. Many desert areas are fertile when irrigated, and a number of villages in deserts depend on irrigation canals. Agriculture in these areas has little effect on military operations except that canals may limit surface mobility. The effect of destruction of an irrigation system on the local population may become an important consideration in an operation estimate.



IRRIGATION DITCH (ALGERIA)
AN EFFECTIVE TANK OBSTACLE

ENVIRONMENTAL EFFECTS ON PERSONNEL

There is no reason to fear the desert environment, and it should not adversely affect the morale of a soldier who is prepared for it, provided he takes certain precautions to protect himself and his equipment. It should be remembered that there is nothing unique about either living or fighting in deserts; native tribesmen have lived in the Sahara for thousands of years. The British maintained a field army and won a campaign in the Western Desert in World War II at the far end of a 12,000-mile sea line of communication with equipment considerably inferior to that in service now. The desert is essentially neutral, affecting both sides equally; the side whose personnel are best prepared for desert operations has a distinct advantage.

The desert is fatiguing, both physically and emotionally. A high standard of discipline is essential, as an individual's single lapse may cause serious damage to his unit or to himself. Commanders must exercise a very high level of leadership and train their junior leaders to assume greater responsibilities required by the wide dispersion of units, normal in desert warfare. Soldiers with good leaders are more apt to accept heavy physical exertion and uncomfortable conditions. Every soldier must clearly understand why he is fighting in such harsh conditions and should be kept informed of the operational situation. Ultimately, however, the maintenance of discipline will depend on individual training.

Commanders must pay special attention to the welfare of troops operating in the desert, as soldiers will be unable to find any "comforts" except those provided by the command. Welfare is an essential factor in the maintenance of morale in an environment that appears—and is—harsh, especially to the inexperienced. There is more to welfare than the provision of mail and clean clothing; although these are important. Soldiers must be kept healthy and physically fit; they must have adequate, tasty, and regular food, and be allowed due periods of rest and sleep. These things will not always be possible and discomfort is inevitable, but if troops know that their commanders are doing everything they can to make life tolerable they will accept the difficulties that arise.

ACCLIMATIZATION

Acclimatization to heat is necessary to permit the body to reach and maintain efficiency in its cooling process. A period of approximately 2 weeks should be allowed for acclimatization, with progressive degrees of heat exposure and physical exertion. Although this strengthens heat resistance there is no such thing as total protection against the debilitating effects of heat. Situations may arise where it is not possible for men to become fully acclimatized before being required to do heavy labor. If this happens heavy activity should be limited to cooler hours and soldiers should be allowed to rest more frequently than normal. A gradual program of work is shown in appendix G

SUN, WIND, AND SAND

Radiant Light. The sun's rays, either direct or bounced off the ground, affect the skin and can also produce eyestrain and temporarily impaired vision. Overexposure will cause sunburn. Persons with fair, freckled skin, ruddy complexions, or red hair are more susceptible to sunburn than others, but all are susceptible to some degree. Sunburn is characterized by painful reddened skin, can result in blistering, and can lead to other forms of heat illness. Soldiers should acquire a suntan in gradual stages, in the early morning or late afternoon, to gain some protection against sunburn. They should not be permitted to expose bare skin to the sun for longer than 5 minutes on the first day, increasing exposure gradually at the rate of 5 minutes per day. In all operational conditions they should be fully clothed in loose garments. This will also reduce sweat loss. It is important to remember that:

The sun is as dangerous on cloudy days as it is on sunny days.

Sunburn ointment is not designed to give complete protection against excessive exposure.

Excessive sunbathing or dozing in the desert sun *can be fatal.*

Wind. The combination of wind and dust or sand can cause extreme irritation to the mucous membranes and chap the lips and other exposed skin surfaces. Irritative conjunctivitis, caused when fine particles enter the eyes, is a frequent complaint of vehicle crews, even if wearing goggles. Chapsticks and skin and eye ointments must be used by all personnel.

Climatic Stress. Climatic stress on the human body in hot desert can be caused by any combination of air temperature, humidity, air movement, and radiant heat. The body is also adversely affected by such factors as lack of acclimatization, overweight, dehydration, alcoholic excess, lack of

Radiant light comes from all directions.

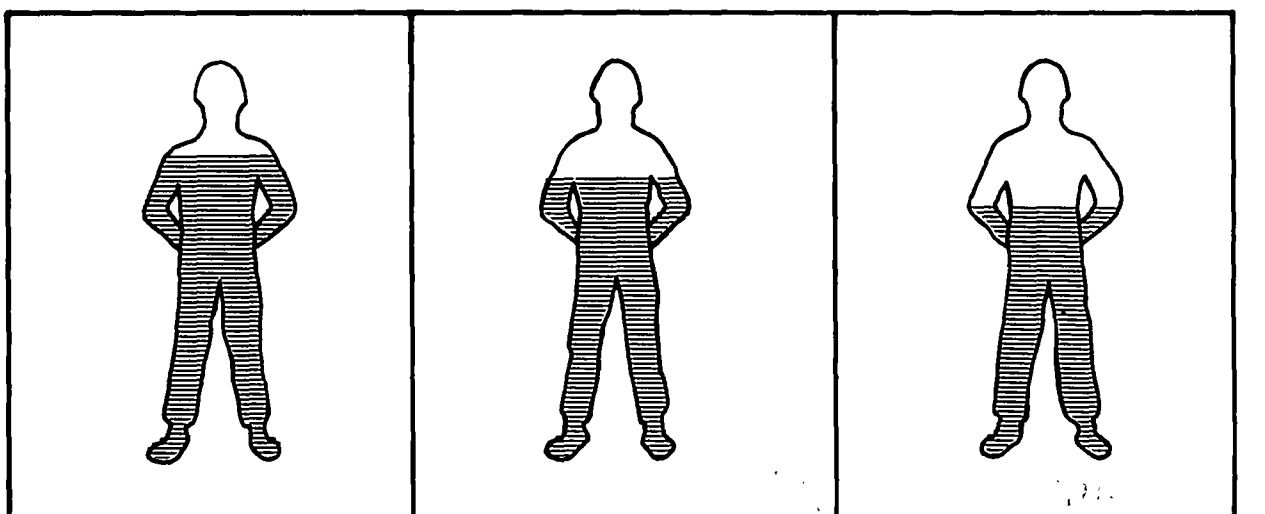
Protect the back of your neck.

sleep, old age, and poor health. The body maintains its optimum temperature of 98.6°F, by conduction/convection, radiation, and evaporation (sweat). The most important of these in daytime desert is evaporation, as air temperature alone is probably already above skin temperature. If, however, relative humidity is high, air will not easily evaporate sweat and the cooling effect is reduced.

Sandstorms. Fast, windblown sand can be extremely painful on bare skin, so this is one reason why persons must always be fully clothed. When visibility is reduced by sand storms to the extent that military operations are impossible, soldiers should not be allowed to leave their group unless secured by lines for recovery.

WATER, DEHYDRATION, AND SALT

Water. Approximately 75 percent of the human body is fluid. All chemical activities in the body occur in a water solution, which assists in the removal of toxic body wastes and plays a vital part in the maintenance of an even body temperature. A loss of 2 quarts of body fluid (2.5 percent of body weight) decreases efficiency by 25 percent and a loss of fluid equal to 15 percent of body weight is usually fatal.



Seventy-five percent of the human body is fluid.	A loss of 2 quarts (2.5 percent body weight) decreases efficiency by 25 percent.	Loss of 12 quarts (15 percent body weight) is usually *fatal.*

Potable drinking water is the most basic need in the desert. It is necessary to ensure that there is no possibility of nonpotable water being mistaken for drinking water. Water that is not fit to drink but not otherwise dangerous (it may be merely over-salinated) may be used to aid cooling. It can be used to wet clothing, for example, so that the body does not use so much of its internal store.

Issue water containers must be used only for drinking water. Sufficient water must be carried on a vehicle to last the crew until the next planned resupply plus a small reserve. Water containers should be carried in positions that:

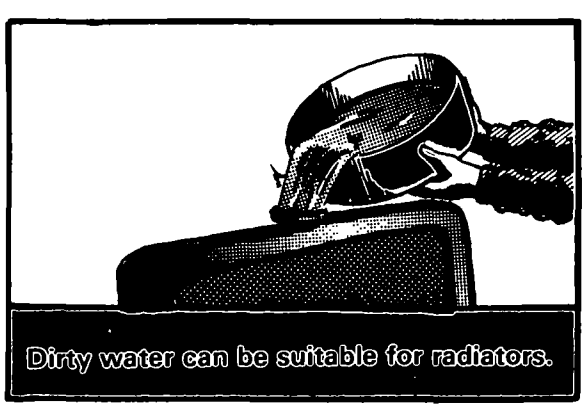
Clamp them firmly to the vehicle body to prevent seams splitting by vibration.

Are preferably in the shade and in an air draft.

Are guarded against the possibility of puncture by shell splinters.

Are easily dismounted in an emergency.

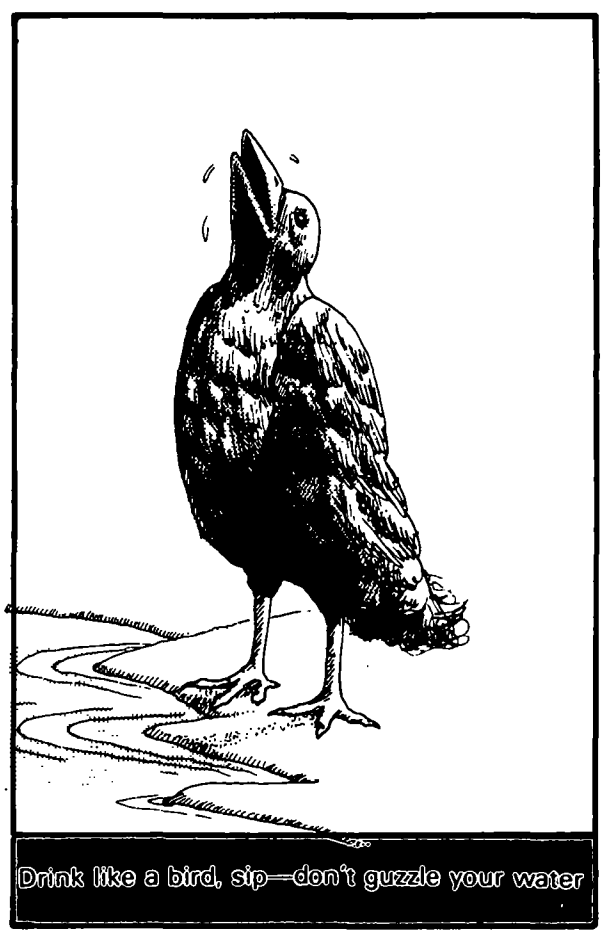
Soldiers must be trained not to waste water. Water that has been used for washing socks, for example, is perfectly adequate for a vehicle cooling system. Drinking water must be taken only from approved sources to avoid disease or water that may have been deliberately polluted. Care must be taken to guard against pollution of water sources. If rationing is in effect, water should be issued under close supervision of officers and noncommissioned officers.



Dirty water can be suitable for radiators.

Soldiers cannot be trained to adjust permanently to a decreased water intake. An acclimatized soldier will need as much if not more water than the nonacclimatized as he sweats more readily. If the ration is not sufficient there is no alternative but to reduce physical activity or restrict it to the cooler parts of the day. Any temporary deficiency should be made up if maximum efficiency is to be retained.

In very hot conditions it is better to take *smaller* quantities of water often rather than large quantities occasionally. The latter case leads to waste by causing excessive sweating and may induce heat cramps. As activities or conditions become more severe, water intake should be increased accordingly.



Drink like a bird, sip—don't guzzle your water

The optimum drinking water temperature is between 10°C and 15.5°C (50-60°F). Lister bags or even wet cloth around metal containers helps to cool water.

Alcohol lessens resistance to heat due to its dehydrating effect. Smoking, particularly during the day, increases the desire for water and should be avoided.

Units performing sustained heavy activities such as a forced march or digging in, may require more than 3 gallons of drinking water per man at 80 degrees Wet Bulb Globe Temperature Index and any increase in the stress will increase this need. A guide to water requirements is shown in appendix G.

Dehydration. During high desert temperatures a resting man may lose as much as a pint of water per hour by sweating. In very high temperatures and low humidity sweating may not be noticeable as it evaporates so fast the *skin will appear dry. Whenever possible, sweat should be retained on the skin to improve the cooling process and the only way to do this is to avoid direct sun on the skin. This is the most important reason why desert soldiers must remain fully clothed.* If a soldier is working, his water loss through sweating (and subsequent requirement for replenishment) increases in proportion to the amount of work done.

Thirst is not an adequate warning of dehydration

Thirst is not an adequate warning of dehydration as the sensation may not be felt until there is a body deficit of 1 to 2 quarts of water. Very dark urine is often a warning of dehydration. Soldiers do not always drink their requirement readily and may need to be encouraged or coerced to drink more than they think necessary, especially during periods of acclimatization. Packets of artificial fruit flavoring will encourage consumption due to the variety of pleasant tastes.

Salt. Salt in correct proportions is vital to the human body, but the more a man sweats, the more salt he loses. The issue ration has enough salt for a soldier drinking up to 4 quarts of water per day. Unacclimatized soldiers need additional salt during their first few days of exposure and all soldiers need additional salt when sweating heavily.

If the water demand to balance sweat loss rises, extra salt must be taken under medical direction. Salt in excess of body requirements however may cause increased thirst, a feeling of sickness, and can be dangerous. To avoid this, these general rules should be followed:

Extra salt should only be taken in proportion to the available extra water.

The quantity taken, in any form, must be strictly controlled according to medical advice.

Salt tablets should not be used unless dissolved into a solution.

A convenient way to provide additional salt when the salt in food is not adequate is to salt all drinking water to a concentration of 0.1 percent. A table listing the quantities required is shown in appendix G. Water must be tested before adding salt as some sources are already saline, especially those close to sea.

DESERT SICKNESS

Heat Illness. The temperature of the body is regulated within very narrow limits. Too little salt may lead to heat cramps; too little salt and insufficient water may lead to heat exhaustion. A general collapse of the body cooling mechanism will lead to heat stroke, which is potentially fatal. To avoid these illnesses, soldiers must be physically fit, thoroughly acclimatized, and drink sufficient water with necessary salt. If soldiers expend more calories than they take in they will be more prone to heat illnesses. Since men may lose their desire for food in hot climates they must be encouraged to eat, with the heavier meal of the day scheduled for the cooler hours.

Continued supervision by commanders and the use of the buddy system are important, especially for those personnel, such as mechanics, who work alone or in pairs. It is necessary to recognize heat stress symptoms quickly. When suffering from heat stroke, the most dangerous, there is a tendency for a man to creep away from his comrades and attempt to hide in a shady and secluded spot; if not found and treated he will die. When shade is required during the day, it can best be provided by tarpaulines or camouflage nets, preferably doubled to allow air circulation between layers and dampened with any surplus water. The major symptoms, and first aid treatment for heat illnesses are shown in appendix G.

Diseases. Diseases found in the desert include plague, typhus, malaria, dengue fever, dysentery, cholera, and typhoid. Some of these can be prevented by vaccines or prophylactic measures. High levels of field hygiene and sanitation are necessary to preclude disease where there are no vaccines or prophylactic measures.

Fungus Infections and Prickly Heat. The excessive sweating common in hot climates can aggravate prickly heat and some forms of fungus infections of the skin. The higher the humidity the greater the possibility of their occurrence. Although many deserts are not humid, there are exceptions, and these diseases are likely in humid conditions.

Respiratory Diseases and Cold Weather Injuries. Soldiers may tend to stay in thin clothing until too late in the desert day and become susceptible to chills, so respiratory infections may be common. Personnel should gradually add layers of clothing at night, (such as sweaters), and gradually remove them in the morning. Where the danger of cold weather injury exists in the desert, commanders must guard against attempts by inexperienced troops to discard cold weather clothing during the heat of the day.

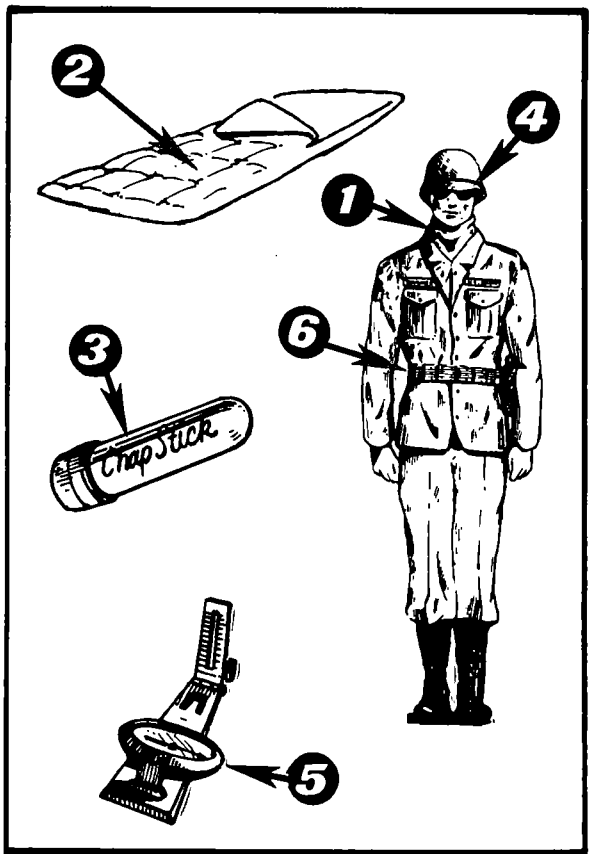
Infections from Polluted Water. Skin diseases can be caused by polluted water; so untested water should not even be used for washing clothes; although it can be used for vehicle cooling systems or vehicle decontamination.

SNAKES

Snakes abound in desert conditions, ranging from the totally harmless to the lethal. As a general rule, a poisonous snake will present a serious danger to an adult only if over 2 feet long, but it is dangerous to touch any snake. Bites from harmless snakes can easily become infected, Snakes seek shade (cool areas) under bushes, rocks, trees, and shrubs. These areas should be checked prior to sitting or resting. Soldiers should always check before putting on boots and clothing in the morning.

CLOTHING

Standard light-weight clothing is suitable for desert operations but should be a camouflage color, not fatigue green. Non-starched long sleeve shirt and full length trousers are worn, tucked into combat boots. Special clothing may be required by tankers, and field and air-defense artillerymen, as they live in an environment of oils and greases and with high risk of burns if their vehicle is hit by enemy fire; this clothing must have an ability to "breathe." Jungle boots should not be worn as sand will sift into them. A scarf or triangular bandage should be worn loosely around the neck. It is used to protect the face during sand storms, as a sweat rag, and to protect much of the face and neck against sand and sun. The helmet liner is adequate for desert use as it offers sufficient airspace for air circulation and gives a certain amount of eyeshade and neck protection; the steel helmet is worn over it in combat. Each soldier should have the following equipment:



HOW TO DRESS

1. Sweater, field jacket, a woolen scarf for cold and night use and a cotton-type scarf for day use.
2. Sleeping bag.
3. Chapstick (some personnel may be allergic to chapsticks and should use vaseline), antisunburn ointment, salt tablets, foot powder, and insect repellant. Eye lotion or drops can also be useful.
4. Sunglasses. These must not hinder peripheral vision and must be kept in a sealed case to prevent scratching when not in use.
5. A lensatic compass, if available.
6. Web belt with 2-quart canteen attached.

Combat boots will wear out quickly in desert terrain, especially if it is rocky, and the leather will dry out and crack unless a nongreasy mixture such as saddle soap is applied. Although difficult to do, clothing must be kept relatively clean by washing in any surplus water that is available. When water is not available, airing and sunning clothing will help to kill bacteria.

HYGIENE AND SANITATION

Hygiene and sanitation are covered in detail in FM 21-10. This paragraph highlights some of the points that are of special importance to the commander in the desert.

Personal Hygiene. Proper standards of personal hygiene must be maintained not only as a deterrent to disease but as a reinforcement to discipline and morale. Daily shaving and bathing are required if water is available. Electric razors, adapted to run from a vehicle power source, should be used instead of "wet shaves." Cleaning the areas of the body that sweat heavily is especially important; underwear should be changed frequently and foot powder used often. If sufficient water is not available, troops may clean themselves with sponge baths, solution-impregnated pads, a damp rag, or even a dry, clean cloth.

Health. Troops should be checked for sign of injury, no matter how slight, as the dirt of the desert or insects can cause infection of minor cuts and scratches. Small quantities of disinfectant in washing water can reduce the chance of infection. Minor sickness can have serious effects in the desert. Prickly heat and diarrhea, for example, can upset part of the sweating mechanism and increase water loss, making the soldier more prone to heat illnesses. The buddy system can help ensure that prompt attention is given to these problems before they incapacitate individuals.

Sanitation. Intestinal diseases can easily increase in the desert. Proper mess sanitation is essential. Trench-type latrines should be used if the soil is suitable but must be dug deep, as shallow latrines become exposed in areas of shifting sand.

ENVIRONMENTAL EFFECTS ON EQUIPMENT

Eight characteristics of the desert environment may adversely affect equipment used in the desert:

- Trafficability.
- Heat.
- Radiant light.
- Dust and sand.
- Humidity.
- Temperature variation.
- Static electricity.
- Winds.

The relative importance of each characteristic varies from desert to desert. Humidity, for example, can be disregarded in most deserts but is important in the Persian Gulf.

TERRAIN

Terrain varies from nearly flat, with high trafficability, to lava beds and salt marshes with little or no trafficability. Drivers must be well trained in judging terrain over which they are driving so that they can select the best method of overcoming the varying conditions they will encounter. Driving techniques in desert conditions are described in appendix C

Track vehicles are best-suited for desert operations. Wheel vehicles may be acceptable as they will go many places that track vehicles can go; however, their much lower average speed in poor terrain may be unacceptable during some operations. Vehicles

should be equipped with extra fan belts, tires, and other items apt to malfunction, together with tow ropes (if not equipped with a winch), extra water cans, and desert camouflage nets. Air recognition panels, signal mirrors, and a tarpaulin for crew antisun protection are very useful. Wheel vehicles should also carry spurs, mats, or channels as appropriate.

The harsh environment requires a very high standard of maintenance, which may have to be performed well away from specialized support personnel. So, operators must be fully trained in operating and maintaining their equipment. Some types of terrain can have a severe effect on suspension and transmission systems, especially those of wheel vehicles. Tanks will often tend to throw tracks on rocks. The unit PLL of tires should be considerably increased as sand temperatures of 165°F are extremely detrimental to rubber and weaken resistance to sharp rocks and plant spines. Items affected by mileage such as wheels, steering, track wedge bolts and sprocket nuts, and transmission shafts must be checked for undue wear when completing before-, during-, and after-operation maintenance.

HEAT

Vehicles. Vehicle cooling and lubrication systems are interdependent, and malfunction by one will rapidly place the other under severe strain. All types of engines are apt to overheat to some degree, leading to excessive wear and ultimately leaking oil seals in the power packs. Commanders should be aware which vehicles types are prone to excessive overheating, and ensure that extra care is applied to their maintenance. Oil levels must be checked frequently, to ensure that levels are what is required (too high may be as bad as too low), that seals are not leaking, and oil consumption is not higher than normal. Radiators and air flow areas around engines must be kept clean and free of debris and other obstructions, and water cooled engines should be fitted with condensers to avoid waste as steam through the overflow pipe. Cooling hoses must be kept tight (a drip a second is 7 gallons in 24 hours). Operators should not remove hood side panels from engine compartments while the engine is running as this will cause turbulence, leading to ineffective cooling.

Batteries. Batteries do not hold their charge efficiently in intense heat. Battery specific gravity will have to be changed to adjust to this environment. The unit can either adjust its electrolyte to 1.200-1.225 specific gravity or obtain sulfuric acid, electrolyte FSN-904-9372 with a specific gravity of 1.2085-1.2185. It may also be necessary to adjust the battery specific gravity to compensate for cold nights. TM 9-6140-100-12 contains information concerning these procedures. Batteries must be kept full, but not overfilled, and a reserve of distilled water should be carried. Air vents must be kept clean or vapors may build up pressure and cause the battery to explode. Voltage regulators should be set low as practical. Dry battery supplies must be increased to offset high attrition rate caused by heat exposure.

Pressure. Severe heat increases pressure in closed pressurized systems such as the M2 Fire Burner unit and increases volume of liquids. Care must be exercized to ensure that working pressure of all equipment is within safety limits and caution must be exercised when removing items such as filler caps.

Thermal Cut-outs. Some items of equipment are fitted with thermal cut-outs, which open circuit breakers when equipment begins to overheat. Overheating is often caused by high ambient temperatures, and can be partly avoided by keeping the item in shade and wrapping it in wet cloth to maintain a lower temperature by evaporation.

Aircraft. Flying time and performance of helicopters is degraded as the altitude and heat increases. Aircraft canopies have been known to bubble under direct heat and should be kept covered when not in use.

Ammunition. Ammunition must be kept away from direct heat and sunlight. If it can be held by bare hands it is safe to fire. White phosphorous ammunition filler tends to liquify at temperatures over 111°F, which will cause unstable flight unless projectiles are stored in an upright position.

Wood. Wood shrinks in a high-temperature, low humidity environment. Equipment such as axes carried on track vehicles can become safety hazards as heads are likely to fly off shrunken handles. Such items must be periodically dampened to reduce shrinkage.

Communication Equipment. Some radios automatically switch on their second blower fan if their temperature rises too high, which normally only happens in temperate climates when they are transmitting. This may disturb soldiers unaccustomed to the environment but is quite normal, as are the frequent squelch bursts that will be heard. AM RF amplifiers are liable to severly overheat and burn out. Such equipment should be turned on only when necessary (they do not affect receiving), but as they take approximately 90 seconds to reach the operating mode the SOP of units using the equipment should allow for delays in replying.

Medical Supplies. During movement and at operation sites where extremely hot temperatures exist, continuous protection is necessary for medical items and supplies, which deteriorate rapidly.

RADIANT LIGHT

Radiant light or its heat effects may be detrimental to plastics, lubricants, pressurized gases, some chemicals, and infrared tracking and guidance systems. Items, like CO2 fire extinguishers, M13 decontamination and reimpregnating kits, and Redeye missiles must be kept out of constant direct sunlight. Optics have been known to discolor under direct sunlight, (although this is unusual) so it is wise to minimize their exposure to the sun's rays.

DUST AND SAND

Dust and sand are probably the greatest danger to the efficient functioning of equipment in the desert. It is almost impossible to avoid particles settling on moving parts and acting as an abrasive.

Mechanical Equipment. Lubrication must be the correct viscosity for the temperature and kept to the absolute minimum in the case of exposed or semiexposed moving parts. Sand mixed with oil forms an abrasive paste. Lube fittings are critical items and should be checked frequently. If they are missing, sand will enter the housing causing bearing failure. Teflon bearings require constant inspection to ensure that the coating is not being removed. Maintenance of engines is critical due to the strong possibility of sand or dust entering the cylinders or their moving parts when the equipment is stripped. It is essential to have screens against flying sand (which will also provide shade for mechanics), and surrounding ground may be soaked in used oil or covered with rocks to bind it down. Mechanics must keep their tools clean.

Aircraft.

Handling. Helicopters should not be moved on the ground under their own power but should be pushed or towed by men or vehicles. Rqn-ups should be restricted to the minimum time and take place on rock or on oiled or wet sand if available. All apertures (pitot tubes, for example) of aircraft not in use should be covered at all times. Hovering close to the ground will lead to sand-ingestion by the engine, possible observation of dust clouds by the enemy, or disorientation of the pilot due to flying sand, particularly at night.

Maintenance. Dust and sand can easily cause failure of such items as cyclic microphone switches, radio and signal distribution panels, circuit breakers and collective triggers, and cause small electrical motors to burn out. Wheel and flight control bearings may require daily cleaning and repacking, and engines should be flushed daily. Rotor heads have reduced life, requiring much more frequent checks than in temperate climates. Particular attention must be paid to sand-caused wear on rotor heads, leading edges of rotor blades, and exposed flight controls. Over 200 pounds of dirt has been known to accumulate in the fuselage area of helicopters operating in these conditions. These areas must be routinely checked and cleaned to prevent a pound-for-pound reduction in aircraft lift capability.

Filtration. It takes comparatively little dirt to block a fuel line, and compression-ignition engines depend on clean air. The abrasive effect of sand in oil has already been mentioned.

Air cleaners of every type of equipment must be examined and cleaned at frequent intervals. The exact interval depends on the operating conditions but should be at least daily.

Filters must be used when refueling any type of vehicle, and the gap between the nozzle and the fuel tank filler must be kept covered. Fuel filters will require frequent cleaning. Oil filters will require replacement more frequently than usual. Engine oils will require changing more often than in temperate climates.

Electrical Insulation. Wind-blown sand and grit will damage electrical wire insulation over a period of time. All cables that are likely to be damaged should be protected with tape *before* insulation becomes worn. Sand will also find its way into parts of items such as "spaghetti cord" plugs, either preventing electrical contact or making it impossible to join the plugs together. A brush, such as an old toothbrush, should be carried and used to brush out such items before they are joined.

Communication Equipment. Dust affects communication equipment such as AM RF amplifiers and radio teletype sets. The latter especially is prone to damage due to its oil lubrication, so dust covers should be used whenever possible. Some receiver-transmitters have ventilating ports, and channels that can get clogged with dust. These must be checked regularly and kept clean to prevent overheating.

Weapons. Weapons may become clogged or missiles jammed on launching rails due to sand and dust accumulation. Sand or dustclogged barrels can lead to in-bore detonation. Muzzles must be kept covered by a thin cover so an explosive projectile can be fired through the cover without risk of explosion; missiles on launchers must also be covered until required for use. Working parts of weapons must have the absolute minimum amount of lubrication. It

may even be preferable to have them totally dry, as any damage caused during firing will be less than that produced by the sand/oil abrasive paste.

Optics. All optics are affected by blowing sand, which will gradually degrade their performance due to small pitting and scratches. It is necessary to guard against buildup of dust on optics, which may not be apparent until the low-light optical performance has severly deteriorated. It may be advisable to keep optics covered with some form of cling film until operations are about to start, especially if the unit is in a sandstorm. Helicopter windscreens must be kept covered if the aircraft is not in use. A cover that has no sand on the underside also should be used and must be secured so it cannot vibrate against the windscreen.

Sand Accumlation. Sand and dirt can easily accumulate in hull bottoms of armored vehicles. This accumulation, combined with condensation or oil can cause jamming of control linkages. Sand accumulation at the air bleeder valve can inhibit heat from escaping from the transmission and result in damage to the transmission. The operator's checks and services increase in importance in this environment.

HUMIDITY

Some deserts are humid. Where this is the case, humidity plus heat encourages rust on bare metal and mold in enclosed spaces such as optics. Bare metal surfaces on equipment not required for immediate use must be kept clean and very lightly lubricated.

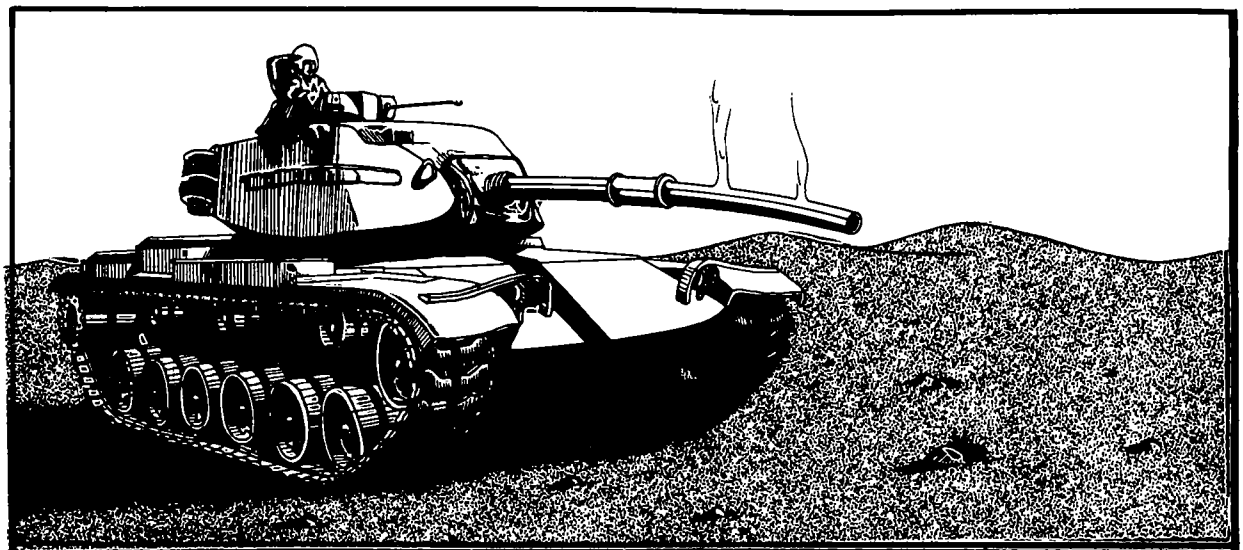
Items such as optics must be stored in dehydrated conditions using hydroscopic material; those in use should be kept in conditions where free air can circulate around them, and should be purged at frequent intervals. Aircraft must be washed daily, particularly if there is salt in the air. Low pressure sprays should be used.

TEMPERATURE VARIATIONS

Condensation. In deserts with relatively high dew levels and high humidity, overnight condensation can occur wherever surfaces such as metal exposed to air are cooler than the air temperature. This condensation can affect such items as optics, fuel lines, and air tanks. Fuel lines should be drained both night and morning and optics must be cleaned frequently. Weapons, even if not lubricated, will accumulate sand and dirt due to condensation, another reason for daily cleaning.

Expansion and Contraction. Air and all fluids expand and contract according to temperature. If tires are inflated to correct pressure during the cool of night they may burst during the heat of day. If fuel tanks are filled to the brim at night they will overflow at midday. Servicing these items during the heat of day can result in under-pressures, overheating of tires and a lack of endurance if the fuel tanks were not filled to their correct levels. Air pressure must be checked when equipment is operating at efficient working temperature and fuel tanks must be filled to their correct capacity as defined in the appropriate technical manual.

Gun Tube Bend. Gun tube bend ("droop") more common in temperate climates, is caused by temperature variations between one side of a tube and the other, such as a cold wind on a hot tube. It totally distorts



the accuracy of a long-barrel, direct-fire weapon such as the 105-mm tank cannon. In the desert, it is usually in the vertical plane due to radiant heat on top of the tube while the lower side is in the shade, thus producing a downward bend in causing rounds to fall short of the target. Gun tube bend can correct itself when the tube has built up an even temperature after a few rounds have been fired. It may be necessary to reboresight as a result of tube bend. Tanks with thermal gun tube covers have built-in compensators.

Instruments. Precision instruments such as range finders may require adjustment several times during the desert day depending on temperature variation.

STATIC ELECTRICITY

Static electricity is prevalent in the desert. It is caused by atmospheric conditions coupled with an inability to ground out due to dryness of the terrain. It is particularly likely with aircraft or vehicles having no conductor contact with the soil. The difference of electrical potential between separate materials may cause a spark between them when contact is made, and if flammable gases are present they may explode and cause a fire. A metal circuit must be established between fuel tankers and vehicles being refueled *before*, and maintained *during* refueling, and they must both be grounded (for example, by a cable and picket or by a crowbar). A further hazard of static electricity is with helicopter sling loads. The hook should be allowed to touch ground before being loaded and a load grounded before being unhooked. Care must be exercised when handling and transporting unlike materials that might generate static electricity. It is also necessary to turn off all switches, uncouple electrical connectors, and ground vehicle or aircraft electrically-operated weapons systems before rearming.

WINDS

Desert winds by their velocity alone can be very destructive to large and relatively light materiel such as aircraft, tentage, and antenna systems. To minimize the possibility of wind damage, materiel should be given such terrain protection as is available and should be firmly picketed to the ground.

PREPARATION FOR DESERT OPERATIONS

Chapter 2 described the desert environment. Because most US Army soldiers and units are unaccustomed to operating in such an environment, it is necessary to make extensive preparations before conducting desert operations.

FACTORS TO BE CONSIDERED WHEN PREPARING FOR DESERT OPERATIONS

When a unit is alerted for operations in a desert environment, the commander must first consider or find answers to some or all of the following questions:

- To what country is the unit going?
- What are the climatic and terrain conditions of that country?
- By what date is the unit to be ready to move?
- What areas in the United States most closely resemble the country?
- Are training areas and ranges present and available in those areas? If not, what alternative arrangements can be made?
- When are training areas and ranges available to the unit, either alone or as a part of a larger force? What arrangments must be made to move personnel and equipment to training areas?
- Will the unit be taking its own equipment overseas? If so, when will the equipment be deployed?

CONTENTS

- If unit equipment is being sent overseas and any items of it require modification (including camouflage painting) when is this work to be done and how long will it take?
- What special equipment does the unit require for desert operations? What arrangements need to be made for this equipment to be delivered, and when will it arrive?
- What special maintenance is required for weapons and equipment before deployment to or arrival in a desert environment?
- Are there personnel in the unit who:
  - Are desert warfare instructors?
  - Have any experience in desert conditions?
  - Can speak any language of the host country, and if so with what proficiency? Is there any requirement that the number be increased and can it be done in the available time frame?
- What assistance is available for training:
  - What instructors are available from outside the unit?
  - What training aids are needed and what is available?
- What larger force will the unit be with? Do they have any special SOPs for desert war? If not, are they producing any?
- Are all personnel physically fit (this will affect the acclimatization period)?
- How many soldiers are nondeployable? They must be replaced.
- What information is available about the enemy in terms of strength, organization, equipment, and tactics.
- What information is available about allied forces in the area of operations?
- What type of operations are expected?
- What is the composition of the advance party and when do they leave?

Once these questions have been answered, the commander must develop a program to bring his unit to a level where it is fully capable of operating successfully in harsh desert conditions. To do this, it is first necessary to set a list of priorities for both individual and unit training. The training priorities listed below are shown as a guide only. They can be modified as necessary depending on the state of readiness of the unit when it is first alerted for desert employment.

Individual Training *Priority*	*Staff and Leaders*	*Specialists* (those to be trained in a desert speciality)	*Team and Crew Members*
(1)	Desert environment and acclimatization	Desert environment and acclimatization	Desert environment and acclimatization
(2)	Survival, evasion, and escape	Survival, evasion, and escape	Survival, evasion, and escape
	Camouflage and concealment	Camouflage and concealment	Camouflage and concealment
	Living in desert	Living in desert	Living in desert
	Operational area	Operational area	Operational area
	Enemy Organization and tactics	Desert Navigation, special equipment techniques	
(3)	Special maintenance and tactical deception	Equipment recognition	Equipment recognition
		NBC training	NBC training
	Communication security	Local Language (if applicable)	
	Desert terrain appreciation		
	NBC training		
	Desert navigation	Enemy organizations	Mines and booby traps
			First aid
			Helicopter marshalling
			Enemy organizations
Unit Training			
	Physical conditioning		
	Weapons training		
	NBC training		
	March discipline		
	Obstacles and barriers		
	Scouting, surveillance, and patrolling		
	Air defense		
	Adjustment and conduct of fires		
	Communications		
	Desert operations		
	Attack		
	Defense		

It is important to remember that a unit is apt to be committed shortly after arrival in the area of operations. Maximum advantage must be made of the preparation time available to the unit. Much of unit training and some individual training can be done in garrison and some individual training subjects can be integrated with unit training. Night operations will be a common occurrence in desert warfare and so training to fight at night as in the day must be emphasized.

INDIVIDUAL TRAINING

The object of individual training is to prepare the individual for operations in a desert environment. This requires both *mental* and *physical* preparation.

In order to fight and survive in desert operations, it is necessary that soldiers fully understand the desert environment and, to the extent practicable, be acclimatized before arrival in the area of operations. The requirement for acclimatization will vary slightly between individuals, but physical conditioning (fit men acclimatize more easily) is a part of the acclimatization process. Acclimatization should take place in climatic conditions that are similar, or slightly more strenuous, than those of the prospective area of operations. For additional information on acclimatization see appendix G.

Camouflage and Concealment. Camouflage and concealment training may be divided into concealment from the ground (including the need to avoid enemy remote sensors (REMS)) and concealment from the air. Particular attention must be paid to movement, color, shadow, and deception. Camouflage and concealment is equally as important for combat service support soldiers as for combat and combat support soldiers. Appendix F contains information about desert camouflage and concealment techniques.

Survival, Evasion, and Escape. Convincing a soldier that he is capable of surviving in the desert environment will do more than almost any other aspect of training to strengthen his self-confidence, and thus his morale. FM 21-76 contains details on survival, evasion, and escape in the desert, but the following points concerning FM 21-76 should be included in desert survival, evasion, and escape training:

- It is unlikely that wells will be poisoned. Some wells in the North African desert, however, have such strong concentrations of mineral salts that water taken from them may lead to intestinal irritation and subsequent illness.
- The section on navigation that should be taught to all personnel is survival navigation and is not to be confused with celestial navigation, which is taught to specialists for unit navigation.
- Although water is undoubtably the most important factor in survival, a soldier should not discard his personal weapon or any navigational equipment he may have except in the most extreme circumstances.

Desert Living. Following minimum preliminary training in garrison, desert living can only be practiced in the field, often as part of unit training. Important aspects that should be covered include:

- The effects of heat, including possible dehydration and salt loss. The need to maintain the body fluid level.
- Maintenance of morale and the ability of the individual to accept the challenge of the desert. Self discipline and common sense.
- Environmental effects such as those of sand, wind, and light.
- Water discipline.
- First aid for heat illnesses. Each soldier should be issued a memory aid card showing symptoms and immediate treatment.
- Hygiene and sanitation.
- Correct clothing and equipment, including how to wear and maintain clothing.
- The effects of temperature variation.
- Precautions against snakes.

To the extent possible, the commander should train his unit in terrain and environmental conditions similar to what he expects to find in the operational area. It would be both short sighted and dangerous for example, to allow such unlimited water that bathing is possible if the expected operational area is totally waterless. To further accustom the soldiers to hardships, contact with garrison or other urban areas should be kept to the minimum except for medical or welfare reasons. Once field training has started, necessary supplies should be brought to field locations and items that are unlikely to be available in the operational area (commercial soft drinks and foods) should not be permitted. To gain the maximum value from this training, the unit should be cut off from all other human contact for the duration of the field exercises.

Enemy Organizations and Tactics. This can be taught in garrison on sand tables and map maneuvers, followed by Tactical Exercises Without Troops (TEWT) and unit exercises in the field. If enemy equipment is available it should be brought to the unit so it can be studied at first hand.

Desert Navigation. Although maps used in field training will be those of the local area, sufficient maps of the operational area should be obtained to allow distribution for study and possible use during garrison training. This is particularly important if the operational maps use foreign words to describe terrain, such as *wadi*, *summan*, *hidiba*, and *dikaka*.

Current equipment employed by units to determine their position in desert is the vehicle dead reckoning navigation set. This set contains items such as protractors, a lensatic compass, and a sun compass including its necessary tables. It is used to deter-

mine approximate magnetic and celestial azimuths and for plotting approximate positions determined by dead reckoning. The sun compass also permits a unit to maneuver on a constant azimuth without the navigator having to dismount continually to take magnetic bearings. The two types of compass are complementary. The sun compass is unaffected by its surroundings, easy to read but requires a higher level of training and cannot be used when the sky is overcast, or at night. The magnetic (lensatic) compass can be used day or night provided its individual compass error and the local magnetic deviation are known; however it is not accurate when used from a vehicle. A magnetic compass may not be adequate on its own when using dead reckoning at night and it may be necessary to employ navigators who have been trained on sextants to establish reasonably accurate positions by the stars. Navigators should, therefore, be trained on dead reckoning, sun compass, and bubble sextant (if available).

Even if the unit is equipped with sophisticated equipment it would be prudent to train a nucleus of personnel on alternative methods. Basic navigation training (including the sextant) takes about 10 days. The use of the vehicle odometer may also be helpful. By multiplying the miles covered by .62, a unit can convert the odometer miles to kilometers.

Operational Area (Host Country). A description of the host country should cover only those facts that apply to forthcoming operations, for example:

- Geographic description.
- Climate (throughout the year).
- Population density.
- Industry and agriculture.
- Language(s) (phrase books may be issued).
- Communications and transportation network.
- Important customs and the behavior expected of US Army personnel. (These can be very important; speaking to a woman in some Arab countries, for example, can be offensive to the local inhabitants).
- The armed forces (and possibly police), including organization, equipment, and rank structure.
- The situation that has led to the introduction of US forces and reasons why US forces are being introduced. No soldier should have to question why he is fighting for a country other than his own, if this is the case.

Treatment of these subjects will vary in degree according to category. Personnel who may require additional information such as the country's history, can find it in the appropriate DA 550 series pamphlet.

Desert Maneuver. Chapter 4 describes the influence of the desert environment on tactical operations. This subject should first be taught as a theoretical subject for a limited number of leaders and commanders, down to platoon level. Leaders then train their own units during unit training. The emphasis should be on small unit tactics, including combined arms operations. Additional subject matter that should be covered includes:

- Terrain in the operational area, emphasizing differences and similarities with the training areas the units will use.
- Application of concealment, using terrain and artificial means such as smoke; the application of maneuver techniques.

- Mobility in the desert.
- Command and control techniques for desert operations.
- Navigation and station-keeping.
- Conduct of fire in desert operations.
- Resupply during desert operations.

Special Equipment Techniques. Nearly all equipment will be affected in one way or another by the environment as described in chapter 2. The purpose of this training is to train operators. Training should include:

- Likely effects on the equipment they operate.
- Efficient operations of the equipment within limits imposed by the environment, including tactical limitations of the equipment (helicopters may have difficulties flying NOE; radios will normally be operated on reduced output due to the environment and enemy ECM, as examples).
- Preventive maintenance, employing any special techniques required by the desert environment. The appropriate equipment technical manual or lubrication order provides specific information concerning hot climate operations and maintenance.
- Basic desert recovery and repair techniques, including defensive measures, and camouflage required during recovery and repair operations.

Instruction must be oriented towards the expected operational area. For example, it is possible to keep radios cool by using ice packs but if ice packs are not going to be available in the area of operations, troops will have been taught a false lesson.

Equipment Recognition. This subject can be divided into four categories:

(1) Enemy ground equipment and helicopters.

(2) Enemy aircraft.

(3) Allied ground equipment and helciopters.

(4) Allied aircraft.

The order of priority and detail of training will vary according to the unit, the degree of equipment identification already known, and individual specialty. The first priority for air defense equipment operators, for example, will be to recognize enemy and allied aircraft visually; a tanker will need to be able to identify enemy ground equipment, but not necessarily over the wide span required by a soldier in military intelligence. Visual recognition will always be a higher priority than sound identification, but the latter should be taught if time and equipment are available. Special emphasis must be placed on allied equipment both ground and air. If both allies and the enemy have similar equipment, separate national identification markings must be taught. Combat service support and combat support units as well as combat units may be required to protect themselves against an enemy breakthrough, so all must be trained in vehicle recognition.

Special Maintenance and Supply Techniques for Staff and Leaders. Special maintenance techniques that need to be addressed are the same as those taught to specialists but need only emphasize aspects that ordinarily require control, supervision, or affect the employment of equipment in desert terrain. This training should include any special handling techniques required in the operational area, using appendix C, appropriate technical manuals and training circulars as background.

The importance and difficulties of supply in desert operations are described in chapter 5. Training should be modified according to:

- Modified table of organization and equipment (MTOE) and mission of the unit.
- Supply situation expected in the area of operations.
- Capabilities of logistic units likely to support unit operations with special attention given to units not normally found in conventional operations (well-drilling teams, transportation cargo carrier companies, for example).

Nuclear, Biological, and Chemical (NBC) Training. Wearing protective clothing and masks in the desert environment will make a person extremely uncomfortable. Soldiers should not participate in strenuous activity while wearing protective clothing until they are acclimatized. Use of protective clothing in severe desert heat is described in appendix D. Points that should be emphasized are:

- The value of being uncomfortable rather than dead.
- The need to avoid heat illness by:
  - Reducing the labor rate to the minimum, and delaying work until cooler hours.
  - Maintaining proper body water and salt levels, particularly during a time of chemical threat.
  - The need for vigilance to detect the first symptoms of heat illness in others.
  - The requirement to increase the time factor of an operation as troops will move more slowly when wearing protective clothing.

Tactical Deception Operations for Staff and Leaders. Enemy tactical operations are directed by doctrine, peculiarities of key personnel, the intelligence picture of the friendly forces, and the area of operations. The enemy's intelligence picture of friendly force capabilities, limitations, intentions, and actions is composed of many interrelated bits and pieces of intelligence. By implementing effective OPSEC procedures, friendly forces can succeed in limiting (blanking out) the enemy's capability to produce accurate intelligence. The enemy continuously endeavors to augment the intelligence collection capability, knowing the friendly forces are capable of limiting enemy intelligence collection assets. Therefore, while friendly OPSEC efforts identify and limit enemy efforts to collect accurate intelligence information, our intelligence efforts must focus concurrently on the planned deception of the enemy.

Some important aspects about deception that should be remembered are:

- Make use of the natural environment, for example, false dust clouds can be created to mislead the enemy as to the intentions of the friendly force.
- The enemy will attempt to deceive as well, so the friendly force must clearly deceive without being deceived.
- Deception operations must be planned and coordinated by the force headquarters planning the operation, normally no lower than division. In any event, the division should limit those deception activities that can be undertaken by its subordinate units without the approval of division headquarters.
- As for any other operation, operation security measures must be taken before, during, and after a deception operation to prevent the enemy from ever knowing that he has been deceived.
- Deception operations must be planned and coordinated by the force headquarters planning the operation, normally no lower than division. In any event, the division should limit those deception activities that can be undertaken by its subordinate units without the approval of division headquarters.

Communication Security. Because of the importance of radio communication in desert operations, it must be expected that the enemy will employ any electronic support measures (ESM) and electronic counter measures (ECM) available to him. Although there are no special electronic counter-counter measures (ECCM) peculiar to desert operations, some points that must be considered are summarized below. Additional information about ECCM techniques can be found in the How-to-Fight manual for the appropriate level of command.

Electronic security. The enemy will try to intercept speech transmissions, attempting to break voice codes in the process, and use the intelligence gained. He will also attempt to determine locations of units, using direction finding equipment. If radios are fitted with on-line cryptographic equipment it should be used to the maximum extent possible, but users must still guard against excessive chatter.

Traffic flow. Variations in the amount of communication traffic can be picked up by the enemy and give warning of impending operations. Message flow must remain constant; although this may mean that routine information, normally sent by radio, must be sent by other means before an operation.

Direction finding (DF). It is probably impossible to totally avoid the danger of direction finding; although electronic silence should be imposed if any alternative means of communication can be used. The following guidelines however can degrade enemy DF capability:

- Transmit using minimum power necessary for the job.
- Use directional antennas. Distant stations should be terrain masked to the front when operating.
- Transmissions must be as short and as few as possible.
- Tactical operations center (TOC) antennas should be located as far from a control station in the TOC as possible.

- If jamming occurs, the following actions should be taken:
  - All stations check that their own transmitters are not inadvertently blocking the net with a "hot microphone." Attempt to work through it without mentioning it on the air.
  - If it is impossible to work through, switch to an alternate frequency according to SOP. One good method is to switch exactly on the next quarter-hour on the clock or some other prearranged system.
  - If sufficient radios are available and blanket jamming is not being used, twin-transmission is helpful. This involves transmitting simultaneously on two frequencies with distant stations picking up the unjammed frequency only.

Concealing antennas This would be relatively easy amid, for example, saguero cactus in the Sonoran Desert. But such aids are unlikely to exist in the Middle East except for vegetation in an oasis. Avoid siting tactical operations centers on high points, in isolated buildings, or areas where new tracks can be easily apparent to enemy reconnaissance. Look for areas that have strong vertical lines such as volcanic cracks, where antennae masts will not stand out. Antennas should be raised only the height necessary for communication with distant stations.

Desert Terrain Appreciation. When training soldiers to appreciate desert terrain, leaders should focus on the effects of different types of desert terrain on capabilities and limitations of unit equipment. It is necessary to highlight the impact of the terrain in the likely operational area on vehicular trafficability, fields of fire, and observation. When possible, crews and small unit leaders should learn to appreciate desert terrain from practical experience in terrain as nearly similar as possible to that in the likely combat zone.

Medical Training Considerations. The unit surgeon can provide valuable information on the medical implications of operations in this environment. He can also advise on measures the unit commanders can take to ensure that training includes preventive medicine concepts essential to keep nonbattle injuries due to environmental factors, to a minimum. These casualties, due to lack of consideration of preventive medicine concepts can far outnumber combat casualties.

UNIT TRAINING

When determining unit training requirements, the commander must first consider the training level of his unit when alerted for deployment. When time does not permit a comprehensive training program, the commander must concentrate on those areas where his unit is least proficient, considering the priorities previously described. In any event, in order to operate in the desert environment the unit must above all, be physically fit, so physical conditioning is of paramount importance.

Physical Conditioning and Acclimatization. To the extent possible these take place simultaneously. When a unit is training in a hot environment, conditioning should begin with physical training at night or

during the cooler part of the day and work up to rigorous training such as foot marches in open sand terrain at midday. Emphasis on mounted operations in desert warfare does *not* imply that foot marching can be totally disregarded. Physical conditioning must be continued after arrival in the area of operations. Medical advice and unlimited salinated water should always be available during periods of physical training in hot weather.

Weapons Training. Soldiers must train to proficiency at all ranges but accuracy at maximum effective range both day and night must be emphasized. Firing should also be done during the heat of day to condition soldier's to heat haze and mirages. Emphasis must also be placed on maintenance of individual weapons in view of sandy desert conditions.

NBC Training. The purpose of unit NBC training is to train individual soldiers to become proficient as a team while wearing protective clothing and masks, and in the case of combat vehicles, while buttoned up. This training should be conducted both day and night, until the unit can operate for up to 48 hours under these conditions. Additional information and guidance is contained in appendix E.

March Discipline. Although of particular importance to combat support and combat service support units, all units should be trained in tactical road marches. Training should emphasize:

Off road movement over open terrain, irregular spacing when moving in convoy, need to maintain sufficient distances between vehicles to preclude "dust blindness" and actions to be taken when stuck in sand, and when a vehicle breaks down;

Vehicle camouflage, removal of tracks which would reveal friendly locations, the need for dispersion when halted, and air defense drills.

Obstacles and Barriers. In some desert areas, natural obstacles such as wadis or other terrain features can be found. Often, however, it will be necessary to use artificial obstacles if enemy movement must be slowed. A minefield, to be of any tactical value in the desert, must usually cover a relatively large area, so mechanical means and engineer support is required to do the job. Since there are often too many avenues of approach to be covered with mines, it is usually best to employ mines to cover any gaps between units, especially at night. Minefields are most effective when they can be covered by observation or fire. During unit training, soldiers should be trained to lay mines using gloves, since human scent attracts desert animals who may attempt to dig them up. Emphasis should be on antitank mine fields since combat vehicles are the most dangerous threat.

Scouting, Surveillance, and Patrolling. This training should emphasize:

Effects of the environment on scouting, observation, and surveillance techniques described in chapter 4, first section, "How the Desert Environment Affects Tactical Operations."

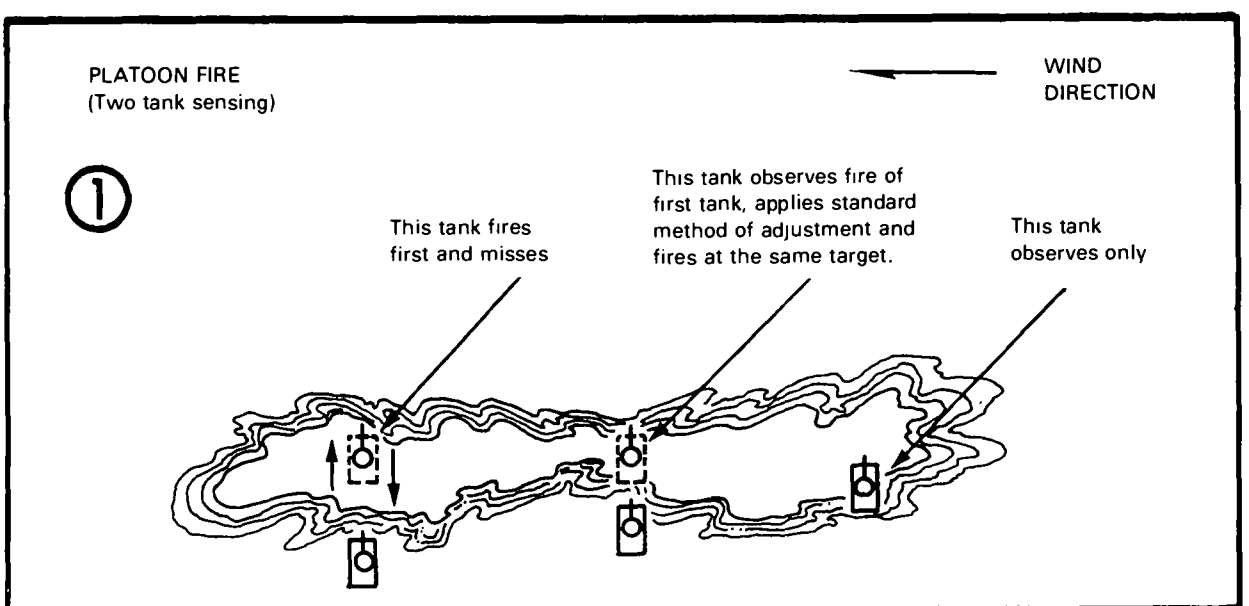
Effects of the environment on surveillance, target acquisition, and night observation devices described in chapter 2, third section, "Environmental Effects on Equipment."

Adjustment and Conduct of Fire. The principles for adjustment and conduct of fire in the desert are the same as for operations in more temperate climates. However, the following considerations, somewhat peculiar to desert operations, should be kept in mind:

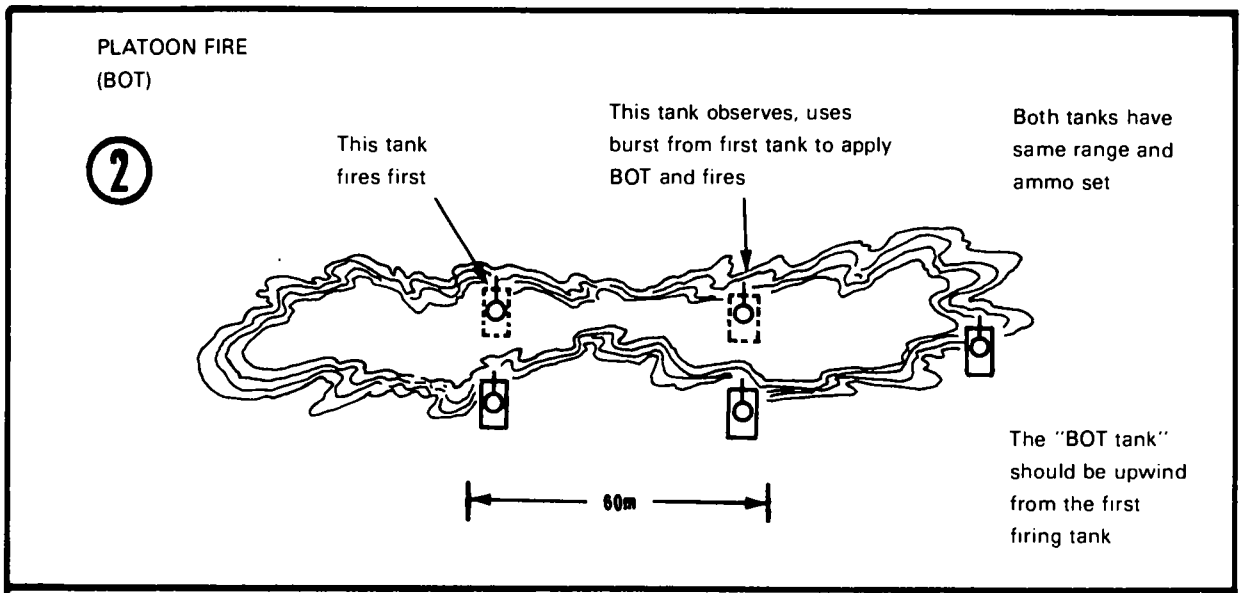
- Obscuration at the gun from either sand, dust, smoke, or in combination can affect direct fire adjustment.
- There may be major inaccuracies of initial rounds from indirect fire weapons due to misjudgment of target location.
- The target may be concealed by sand or dust if rounds land short, on, or near the observer target line.
- Heat haze and mirages can mislead gunners and observers as to target location. This condition can particularly affect antitank guided missile gunners.

Gunners should concentrate on looking *through* obscuring conditions, not *at* them. Armor piercing discarding sabot, for example, will emit a vivid flash when striking armor. This can frequently be seen through dust and dirt; although it may also produce the same effect if striking short on rock. Direct-fire gunners may have to depend on flank observers, who may be any individual on the battlefield equipped with a radio. If observation is lost, subsequent corrections are very unlikely to cause a second round hit. Gun crews will have to use standard range changes or preferably target form adjustment. Both of these methods rely on the gunner maintaining an accurate sight picture over the whole of his reticle as the immediate front of the target will be totally obscured by flying dirt if the round landed short.

There are techniques that can be used to overcome the obscuration/sending problem. For example, a heavy section of a tank platoon firing APDS might use either of the following techniques:



All tanks start the engagement with same range and ammunition indexed



Distance between tanks must be no greater than 60m

An observer requesting *indirect fires* may need to ensure that initial rounds land beyond the target to preclude short rounds obscuring the target. He then adjusts accordingly. It may also be necessary to use white phosphorus (WP) ammunition to ensure that fall of shot is observed.

Heat haze varies throughout the day. Its greatest impact is on ATGM gunners when both gunner and target are within 2-3 feet of the desert surface. Therefore ATGM gunners should have a line of sight approximately 6 feet above the intervening terrain, and preferably be sited so the sun is behind them.

Air Defense. In desert operations any type of unit, be it tank, infantry, trains, tactical operations centers, or supply points, can expect to be a target for air attack. Air attacks may be from fighter bomber aircraft using cannons, missiles, bombs, napalm, and machineguns or from attack helicopters using machineguns, rockets, or missiles.

Enemy air superiority should be assumed during all field training, and simulated fighter bomber attacks and attack helicopter missions should be flown against the unit whenever possible. When practical, aerial photographs of positions should be taken and pilots interviewed to assist in critique of air defense, both passive and active. Points that should be emphasized are:

- *Passive air defense measures* should be taken routinely. When stopped for any period of time, every advantage should be taken of whatever cover and concealment is available. As previously described, natural cover and concealment will be difficult to find in many desert areas. Nevertheless vehicles, particularly unarmored vehicles, should be irregularly dispersed and dug-in, or revetments provided. When appropriate, air

guards, trained in aircraft recognition, should be posted, with clear instructions on actions to be taken when aircraft are sighted. Artificial camouflage can be used as described in appendix F.

- *Active air defense* techniques used in desert operations are the same as those described in other How-to-Fight manuals, appropriate to the level of command. However, at small unit level, additional emphasis should be given to air defense using small arms. When combat vehicles on the move are engaged by enemy aircraft their immediate action will depend on whether or not they are maneuvering in contact with the enemy. If they are in contact they should continue to maneuver, relying on some overwatch elements and air defense artillery to engage attacking aircraft.
  - Vehicles about to be engaged by enemy aircraft in an area where cover is not available, should move perpendicular to the attacking aircraft to evade rocket or machinegun fire. Engage the aircraft with small arms fire, if possible. The remainder of the unit meanwhile should mass small arms fire to the aircraft's front. Sudden variations in course may also distract the pilot.
  - When attacked by napalm, vehicles should turn in the direction of the attack, stop and switch off engines to avoid napalm ingestion, button up, fire the smoke launcher system if so equipped, while firing machineguns in the direction of the attack.

Communications. Good communications in this terrain will often depend on the state of mind of the operators. They must be enthusiastic, persistent, and determined to make and maintain contact. Commanders will probably find that it is usually the same station(s) that lost contact first. Unit training should concentrate on ECCM techniques. When conducting field training, higher headquarters can provide assistance in the form of small teams to jam unit nets. Actions taken when radio contact is lost due to heat, described in appendix C, should be practiced.

Desert Operations. This training should be as realistic as possible. Field training should be constrained by environmental influences on tactical operations as described in chapter 4.

OPERATIONS IN DESERT CONDITIONS

In the two previous chapters, the environment and its effects on personnel and equipment and preparation for desert operations were described. This chapter describes desert operations and is divided into four sections:

How the Desert Environment Affects Tactical Operations
The Enemy in Desert Operations
Offensive Operations
Defensive Operations

CONTENTS

HOW THE DESERT ENVIRONMENT AFFECTS TACTICAL OPERATIONS

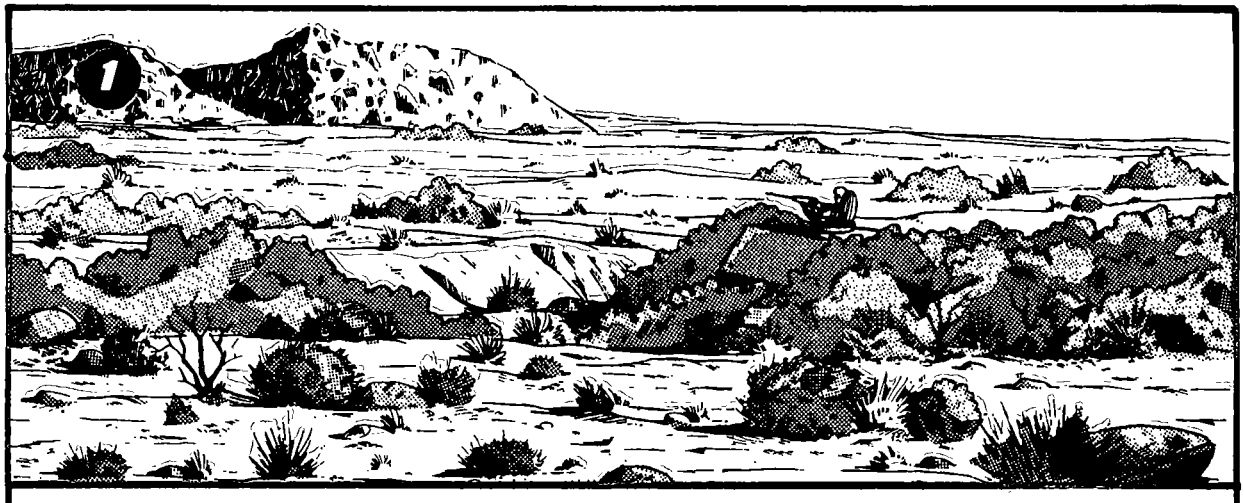
The environment of the desert, together with its effects on personnel and equipment requires some modification to tactics and procedures described in other How-to-Fight manuals. Important physical characteristics that influence desert operations are:

- Terrain.
- Lack of both natural and man-made combat service support assets.
- Lack of concealment.
- Excellent observation and fields of fire.

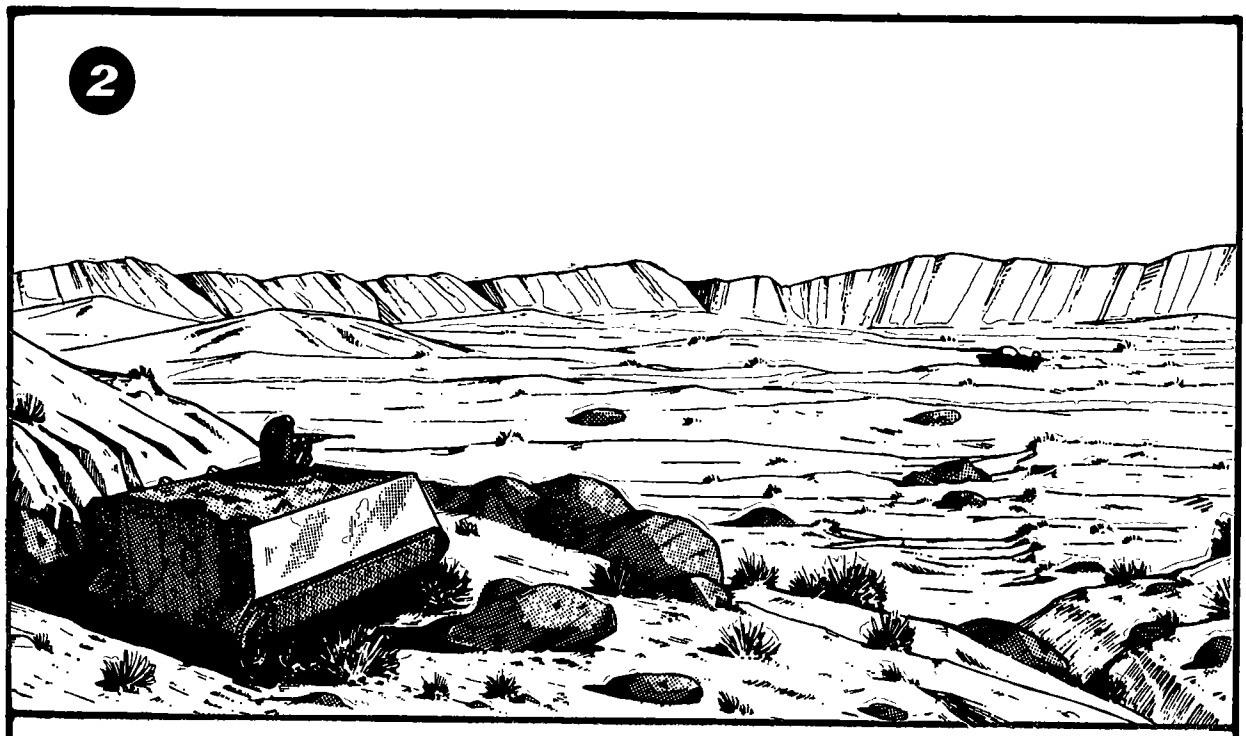
Advantages or disadvantages accruing from these characteristics are equally applicable to an enemy force. This section describes how these characteristics influence tactical operations.

OBJECTIVES

The objective of unit operations in desert warfare is destruction of the enemy. Key terrain features are scarce in many desert areas; although they do exist in some, such as the passes of the Sinai. Therefore, units are seldom tasked to seize or retain specific terrain features. It may however, be necessary to secure terrain for water sources, routes, or communication sites; or to control positions that permit observation even though only a few meters higher than the surrounding area.



POOR OBSERVATION TECHNIQUE



OBSERVE FROM HEIGHT IF POSSIBLE

MOBILITY

Tactical mobility is the key to successful desert operations. Obstacles and areas such as lava beds or salt marshes, which preclude surface movement, do exist. But most deserts permit true two-dimensional movement by ground troops similar to that of a naval task force at sea. Speed of execution is essential and requires self-contained all-mechanized or airmobile forces with excellent communications. Dismounted infantry are used in areas where vehicle movement is limited, such as mountains, or sometimes to establish strongpoints and blocking positions.

Use of natural desert obstacles may permit a force to establish a defensive position that theoretically cannot be turned from either flank; however these are rare. For example, only 5 natural defensive positions exist over a distance of 3,800 kilometers west of El Alamein in Egypt. In any case, an attacking force capable of airmobile or extended ground operations can usually find a way over or around an obstacle. The defending force can then be bypassed, contained, or taken from the rear.

Limited cross-country capability of supply vehicles, (especially that of water tankers or those towing trailers), combined with longer lines of communication, may influence avenues of approach of a large force. The limited hard-surface routes that do exist will be necessary for resupply.

OBSERVATION AND FIELDS OF FIRE

The normally flat desert terrain permits direct-fire weapons to be used out to their maximum range. However, the desert is not absolutely flat, so weapons are sited to provide mutual support as in temperate climates. When preparing defensive positions it is important to inspect the positions from the enemy point of view to ensure that available cover and concealment are maximized.

Open terrain and a predominantly clear atmosphere generally offer excellent long range visibility, but at certain times of the day it may be limited or distorted by heat effects. Dust from helicopters flying NOE can be seen from a distance of 20-30 kilometers and columns of vehicles can be easily identified at more than 5 kilometers from observation posts on dominant terrain. Often the first indications are flashes from wind screens or optics, rather than by the accompanying dust column. The ideal observation position should have the sun behind it and be as high as possible to lessen the effects of mirage and heat radiation from the ground. When there is no unusable dominant terrain available, the only means of observation may be from an aeroscout, or limited to short range observation by the tank commander.

Observation of fires, especially direct fires, may be difficult. Considerable dust clouds can be thrown up by high velocity, direct-fire weapons. Calcium chloride distributed in front of a position may lessen them; however burst-on-target corrections may be almost impossible. Crews may have to use flank observers to report elevation and azimuth errors. Correction of field artillery fires, especially those of larger pieces, may be complicated by dust hanging in the air following the impact of ranging rounds. Forward observers should, therefore, place initial rounds beyond a target rather than short of the target.

MANEUVER

Small units move, employing movement techniques described in FM 71-1, *The Tank and Mechanized Infantry Company Team.* Maneuver must be at maximum tactical speed permitted by the terrain and dust conditions, using whatever cover is available. Even a 10-foot sand dune will cover and conceal a tank. Air defense coverage is always necessary as aircraft can spot movement very easily due to accompanying dust clouds.

To achieve surprise it is almost always necessary to maneuver in conditions that preclude observation—at night, behind smoke, or during dust and sand storms. Control of maneuver during sandstorms is difficult but not impossible, and with favorable winds (supplemented if necessary by smoke) an attack or maneuver can be made behind a sandstorm. In certain circumstances, there may be no alternative to maneuver in terrain where the enemy can observe at long range. Then it is necessary to maneuver at best speed, while suppressive fires are placed on suspected enemy positions by field artillery or close air support aircraft.

RECONNAISSANCE AND SECURITY

The almost complete freedom of maneuver of units in the desert, together with the ability and requirement to observe great distances, requires aggressive and continuous reconnaissance and constant *all-round*

security. Many desert maps are inaccurate, which also makes up-to-date terrain reconnaissance necessary. Reconnaissance must be by all ground and air means to the limits of the unit's area of interest. Route reconnaissance is seldom employed, but if it is required, units involved must expect to operate over extended distances. Zone reconnaissance is frequent, and zones are normally larger than in temperate climates. Area reconnaissance missions and techniques are unlikely to alter significantly from those in more conventional terrain.

Units must provide for all-round security at all times. When a force is in a defensive position particular attention must be paid to all-round surveillance and *gaps* between units. The threat of enemy air attack is always present; therefore passive and active air defense measures must be stressed. Ground patrols, radar, sensors, and aerial and ground mounted surveillance devices provide additional means of security at night and during periods of limited visibility. Passive devices should be used whenever possible.

Ground scouts normally move 2,000-4,000 meters to front or flanks of leading teams, depending on terrain. They depend on field artillery or mortars, and possibly attack helicopters, for immediate support. This distance is required, however, to give squads time to dismount observers and send them forward, and to give the commander time and space to react to their information without inhibiting the movement of their parent unit.

Aeroscouts flying NOE can not necessarily find the enemy more easily than ground observers. Stationary targets are the most difficult to see as there is little to draw the observer's attention; so aeroscouts must use caution to avoid blundering into enemy air defense weapons. One method that can be used is "dismount and scan." Starting at a distance of 5-10 kilometers from the area of interest, the aircraft lands and the observer dismounts and scans the area for suspected enemy. The observer must remain in contact with the pilot, using a portable radio. The process is repeated at varying intervals, until contact is made.

Observation posts should be sited in pairs, as far apart as possible to permit accurate resection, and at different heights to avoid the possibility of dust clouds blocking the vision of both simultaneously. It is best to emplace observation posts by helicopter at night. Observers should be dropped off some distance from the designated position and move the remainder of the distance on foot to reduce the chances of enemy observation.

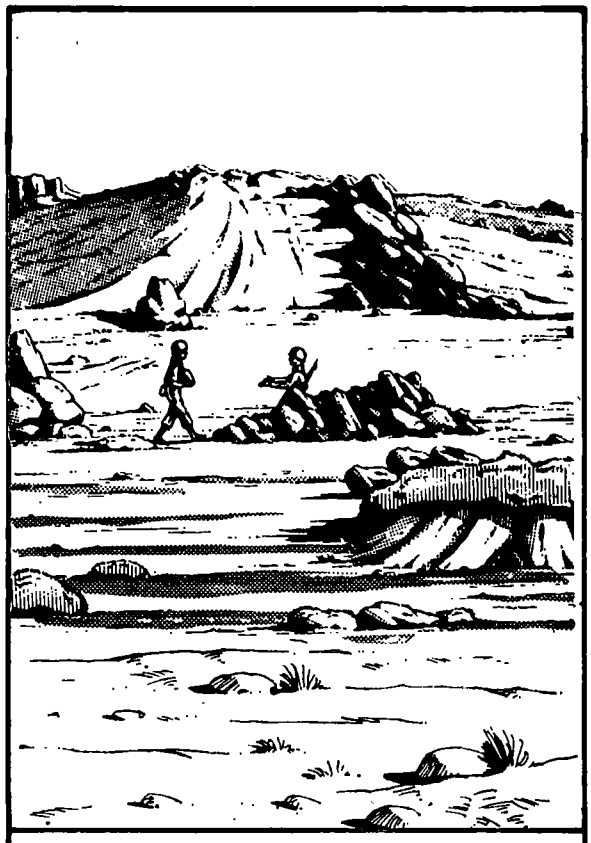
Radars are unlikely to be affected by heat haze so may be valuable on flat terrain during midday heat if optical vision is hopelessly distorted. They are almost useless in sandstorms. Image intensification is of limited value in sandstorms, and at night will depend on the phase of the moon. If there is no moon, artificial illumination outside the field of view of the system will have to be used. Since thermal imagery devices depend on the difference between ambient temperature and equipment temperature, they are more useful at night than in the day.

Patrols perform most often mounted, dismounting only when necessary to accomplish the mission. They follow the principles described in FM 71-1, *Tank and Mechanized Infantry Company Team* and FM 21-74 (Draft), *Patrolling.*

COVER AND CONCEALMENT

This paragraph describes the influence of the environment on cover and concealment and certain techniques to be used in the desert. Additional techniques can be found in appendix E.

Cover. When moving in the desert, cover can only be provided by terrain masking due to lack of heavy vegetation or man-made objects. When dug in positions are prepared for tanks and personnel carriers, irregular-shaped scoops approximately 2 meters deep in the center and 3 times the vehicle width in approximate diameter should be used. These more closely resemble natural depressions in the desert floor. If the ground is extremely rocky and engineer assistance is not available, it may be necessary to build sangars for dismounted infantry. These are made of the largest rocks available which must be securely wedged together with a 1-foot slope on each side for each 4 feet in height. Walls are lined with sandbags. They must be as small as possible in diameter, holding 3 or 4 men each.



SANGAR

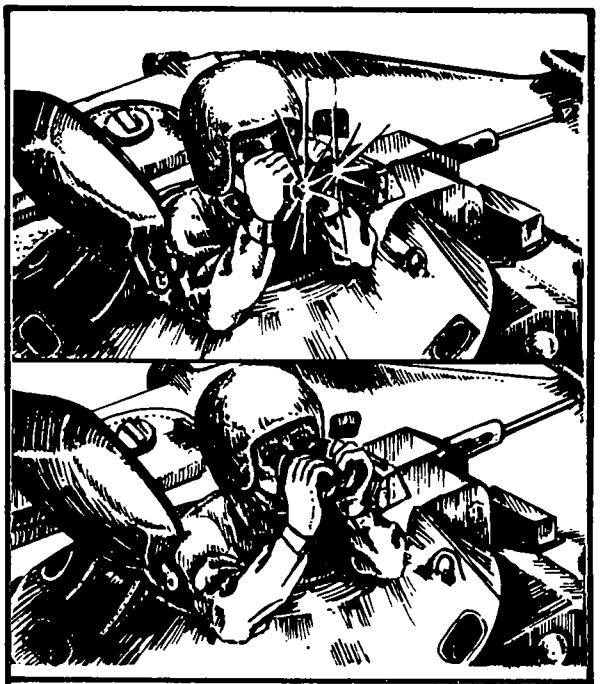
Concealment. Total concealment is rarely achieved, but camouflage properly used, although not totally concealing an object, can make it impossible to perceive what the object is.

Movement. Any form of desert movement creates dust. Moving directly across country on the hardest ground available reduces dust clouds. Vehicles should not directly follow each other (unless there is a serious danger of mines), as many desert surfaces are thin, hard crust with dust underneath, and the crusts are easily broken. Helicopters may have to operate higher than normal to avoid noticeable dust signatures, which must be considered when planning for employment of attack helicopters.

Shape. The problem of shape is the same as in temperate climates but is made more difficult by excellent observation and lack of concealment in desert terrain. A certain amount can be done by covering vehicles with scrub held on with chicken wire to attempt to harmonize with the background. Gasoline and water trucks, which are usually prime targets for enemy attack, should have canvas covers over their bodies so that they resemble standard cargo trucks. Desert camouflage nets must match the color and texture of the ground and must also be complete covers as the standard net which relies on casting irregular shadows is useless in this terrain. Antenna farms at command posts must be avoided by remoting radios in different directions from the TOC.

Shine. Shine is avoided on vehicles and equipment by using matte camouflage paint, covered if necessary by mud or a thin mixture of grease and sand. This mixture, however is unsuitable for aircraft, which must rely on paint alone. Vehicle windshields may be covered with cloth, thin enough to allow vision through it. All aircraft optical devices must be covered when not in use, even at night. Optics such as gunsights and binoculars should be kept shaded. Shiny items such as mapboards and mess kits must be used with caution.

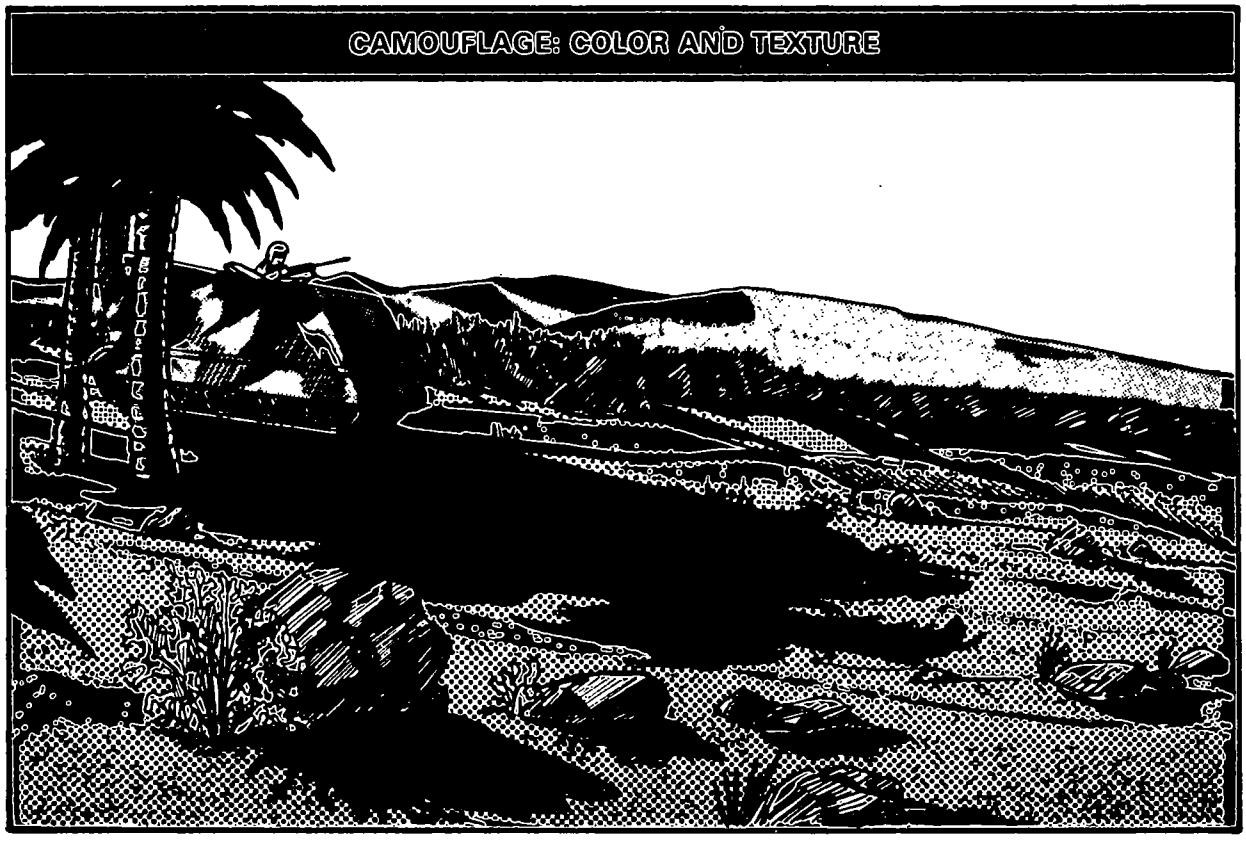
Shadow. Because there is little vegetation in most deserts, strong shadows are readily observed from the air. Shadows can be disrupted by altering the equipment shape, using the correct angle to the sun to minimize shadow size and to cause shadows to fall on broken ground or vegetation whenever possible. The best solution is to dig-in, and use overhead cover or, at least, camouflage nets. It is also necessary to move vehicles and equipment as the sun moves.



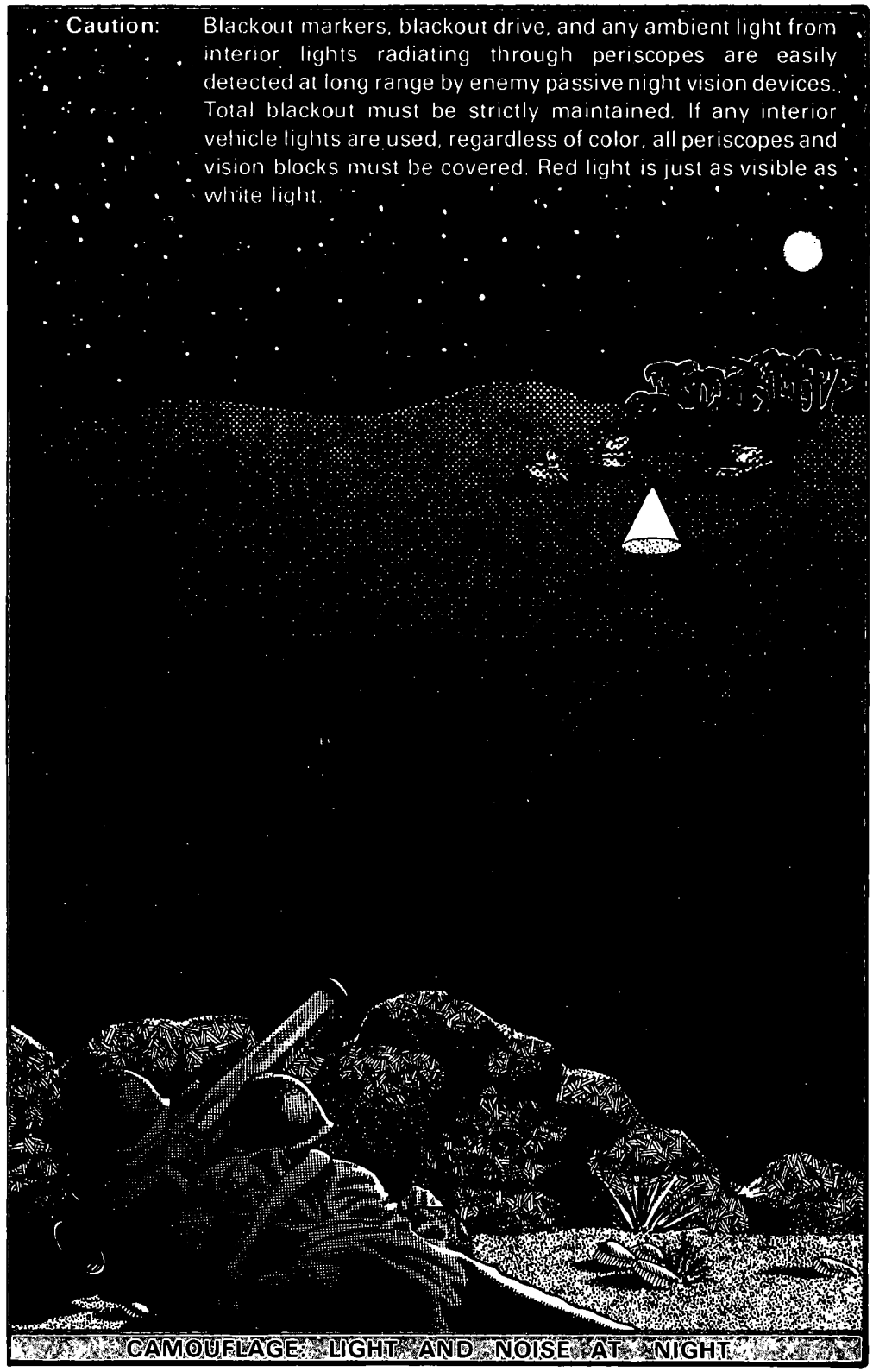
SHADE OPTICS TO PREVENT SHINE

CAMOUFLAGE: EFFECT OF SHADOW

Color and texture. All equipment should be pattern painted to blend with terrain and texture. Desert patterns and colors are described in TC 5-200 "Camouflage Pattern Painting." Any available local materials can be used to improve or vary the camouflage paint.



Light and noise. Light and noise at night may be seen or heard from miles away, so strict light and noise discipline is necessary. Enemy passive night vision devices are capable of picking up light sources of any color at ranges far in excess of the unaided eye. One momentary lapse may be sufficient to attract enemy attention and permit enemy resection. Essential noise such as that produced by generator motors must be muffled and kept to the minimum. All engines should be started together. This will confuse the enemy as to the number and direction of the vehicles. Lights must not be used inside any vehicle unless there is no possibility of leakage. Command vehicles should be equipped with automatic door switches and blackout vestibules. If external lights have to be used for any purpose, they should be dark blue or dark green and capable of being dimmed by rheostats. Items such as brake lights should be permanently covered.



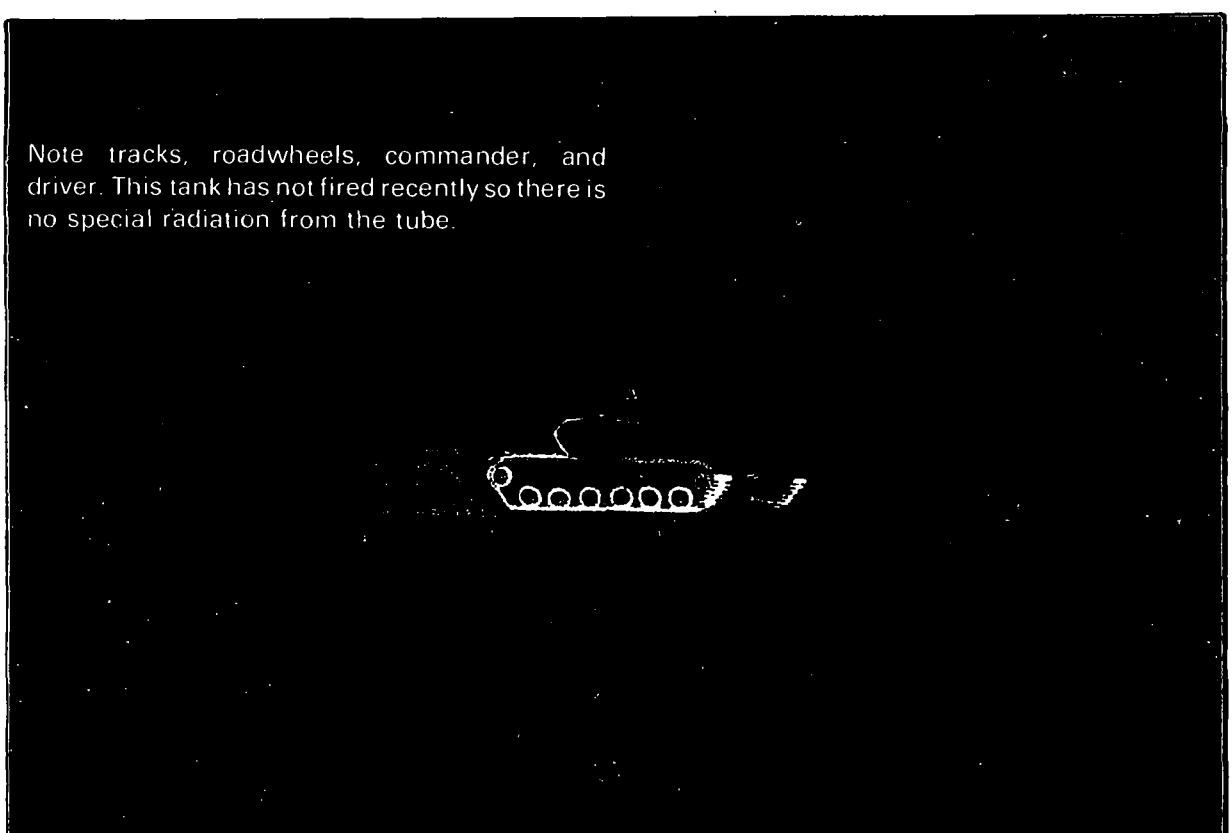
CAMOUFLAGE, LIGHT AND NOISE AT NIGHT

Heat. A thermal sensor, which can build up a picture of a target, is passive, and can penetrate limited camouflage and smoke screens as heat has greater penetrating power than light. It relies on temperature differences between a target and its surroundings; the greater the difference the better the resolution. It should not be as efficient in the desert day as it would be at the same hour in cooler climates but will be very useful at night. So it is particularly necessary to shield heat emission sources at night.

Smoke. In order to conceal movement, it is often necessary to use smoke in great quantities, both day and night.

Smoke does not provide total protection. It only degrades the enemy's close observation capabilities. Radars are not affected by smoke, so troops and aircraft operating behind smoke can be seen by enemy radar. Thermal imagery can also see through smoke; although the higher the ambient temperature the less effective this will be.

Smoke is affected to some degree by desert weather. Turbulent air conditions at maximum temperatures for example, may cause white phosphorus to pillar and break up rapidly. A steady desert wind of approximately 5 knots across the target in the lower temperatures of morning and evening are the best conditions for a deliberate screen.



THERMAL IMAGE OF TANK AT NIGHT

There are four general categories of smoke employment in desert warfare:

- *Large-area smoke screen.* Normally preplanned (as it often requires prestocking of ammunition) and fired by field artillery or mortars; smoke generators can also be used, especially when crossing obstacles. A screen of great density, width, and duration will probably alert the enemy that movement is in progress. However, large screens can also be used in a deception plan.
- *Small-area smoke screen.* Normally laid down by battalion task force mortars or tank guns. This type of screen will be the most common employment of smoke in the desert. Commanders should consider carrying more smoke ammunition in mortar platoons and company headquarters tanks than would be normal in temperate climates.
- *Identifying smoke.* A forward observer or other person directing field artillery fire may choose to use smoke to identify ranging rounds when they strike, particularly in areas where significant terrain features are totally absent. It is also useful to mark targets for close air support.
- *Local smoke.* Local smoke is fired by a tank that has been caught in the open by enemy fire and will sometimes be the first indication to an overwatch element that the enemy is firing. The tank commander uses smoke to conceal his movement to a hull down position while overwatch vehicles engage the enemy. Commanders must guard against any tendency to allow an attack to lose momentum by overuse of local smoke.

EMPLOYMENT OF ARMY AIRCRAFT

Army aircraft may be employed in the desert as in temperate climates, within limits imposed by enemy long range observation and air defense fires. Some degradation in aircraft performance is to be expected due to environmental effects. Employment of Army aircraft is described in appendix B.

NAVIGATION

Navigation Effectiveness. A force may be equipped with modern, sophisticated navigation means with the ability to record positions with errors of less than 1 percent. A force not equipped with such systems may find navigation difficult, depending on the number of visible and known terrain features, and the reliability of local maps.

It is often necessary to appoint a specific person in each company team and battalion task force whose primary task is navigation. He should be qualified in celestial navigation.

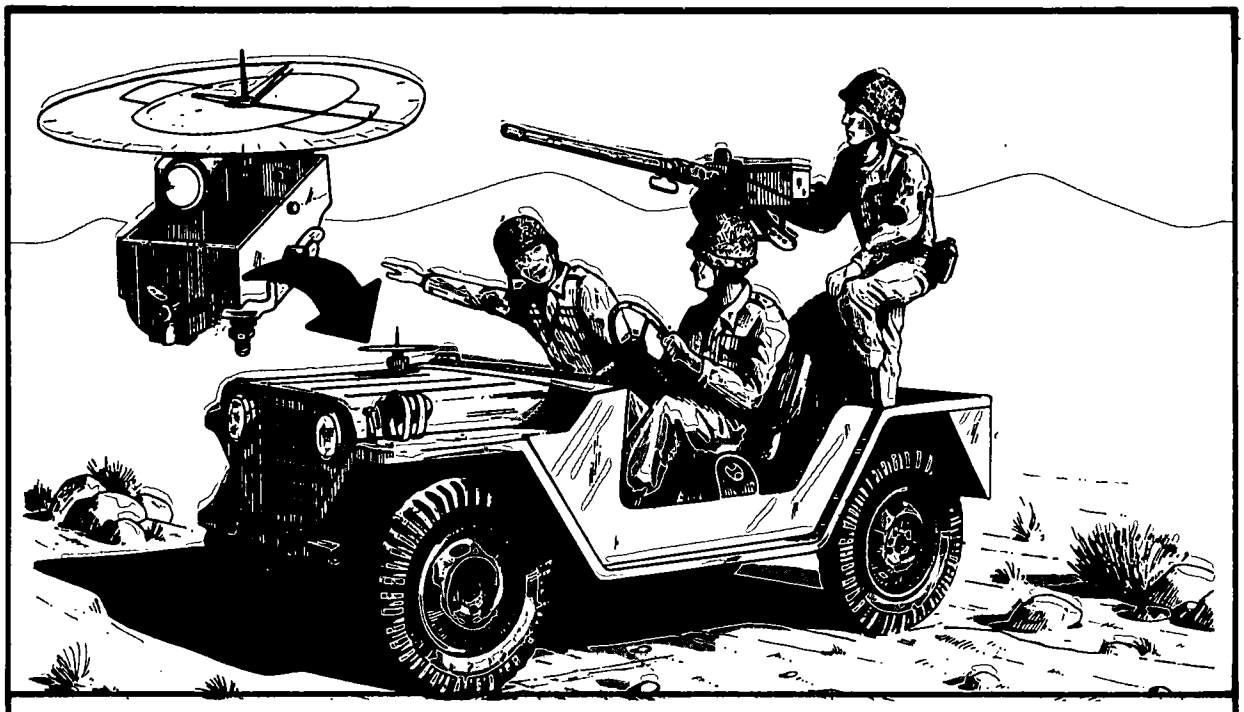
Soldiers must be thoroughly briefed on the type of terrain and the general environment they will encounter, including:

- Water sources, if any.
- Landmarks or significant permanent terrain features
- Friendly and enemy areas of operation.
- Prevailing winds.

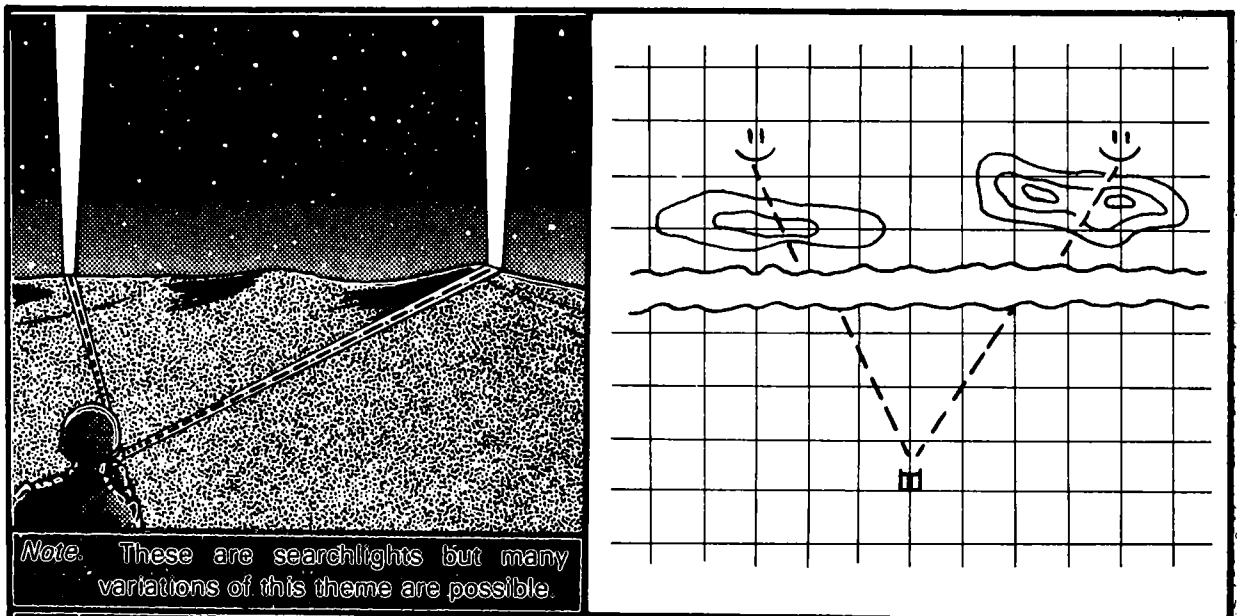
This information will assist navigation by reconnaissance units or individuals who become separated from their units.

Navigation Aids. These vary in sophistication and complexity and may include:

- *Sun compasses.* These can be used on moving vehicles, and sextants (both require accurate time keeping).
- *Lensatic compasses.* Individual compass error and local deviation must be known. They are unreliable near quantities of metal and can also be affected by underground mineral deposits. They are almost impossible to use with accuracy on a vehicle.
- *Gyro compass.* An efficient gun azimuth stabilizer used on fairly flat ground is useful for maintaining direction as it is, in fact, a gyroscope.
- *Fires.* Planned tracer fire assists in maintaining bearings, and field artillery and mortar concentrations, preferably smoke (or illumination at night) are useful checks on estimated locations.
- *Distance recorders.* It is essential to record distance moved, which may be done by using a vehicle odometer.
- *RF beacons.* These are particularly useful for aircraft navigation, but can also permit the enemy to locate friendly forces. It may be necessary to place them in open desert with unit locations being marked at certain distances and bearings from them.
- *Radars.* Provided the position of a radar is known, it can measure range and bearings and therefore position of a vehicle.
- *Homers.* These may be used in any terrain but suffer from the same disadvantage as RF beacons, to a greater degree.
- *Aerial photographs.* The advantage of aerial photographs particularly to aviators, is their ability to show up-to-date views of the variation in color and texture of the desert soil.



SIMPLE SUN COMPASS IN USE



USING RESECTION ON THE VERTICAL BEAMS OF PREPOSITIONED LIGHTS.

- *Prepositioned lights.* This method consists of placing two or more searchlights far apart behind the line of contact beyond enemy artillery range and concealed from enemy ground observation. Units in the area determine their locations by resection, using the vertical beams of the lights. The enemy air threat may require the lights to be well away from friendly units. Lights should be moved on a time schedule known to each unit.

Checkpoints should not be used unless there is no doubt of the checkpoint position on the ground. It is usually better to use coordinates.

IDENTIFICATION

Identification Friend or Foe (IFF) is a problem for ground troops and even more difficult for aircraft. National identifying marks are not sufficient, so it is necessary to have a thorough knowledge of vehicles used by both enemy and allied forces. The force should have a standing IFF operating procedure, allowing for daily changes. Systems that can be used include:

- Tape markings, white or multicolored.
- Colored pennants in different daily positions. These should not be flown from antennas as they may degrade radio performance. Unless they are carried by all vehicles they may assist the enemy to identify headquarters vehicles. They may be of negligible value in very dusty conditions.
- A known common radio frequency for IFF only.

COMMUNICATIONS AND ELECTRONIC WARFARE

Communication.

Wire. Wire communication is not used extensively except in rear areas, as maneuver units are unlikely to be in one place very long. If wire is used it should be buried to a minimum depth of 12 inches to avoid damage from track vehicles or shell fire.

There must be plenty of slack in the line to allow for sand shift. Accurate map plots of buried wire should be kept. If *overhead* wire must be used, it should be mounted on posts erected in the form of tripods to avoid falling during severe wind storms. Blowing sand can damage insulation, so continued maintenance is necessary.

Radio. Radio is the primary means of communications in desert operations due to speed of movement and distances involved. It may be necessary to use air or ground relays during the hottest periods of the day as VHF (FM) radios can have their range degraded by as much as 50 percent.

Some areas of desert are "dead spots," normally due to certain minerals below the surface, and are totally unacceptable for command posts. Communications must be established with all subordinate units from a newly selected position *before* the headquarters moves from the old position.

Liaison officers and messengers. Air or vehicle mounted liaison officers or messengers can be used if units are stationary or under listening silence. They should be proficient in navigation and equipped to destroy the message if liable to capture.

Pyrotechnics and sound. Pyrotechnics are usually more effective in temperate climates; although heat mirages and dust storms may impair or restrict their use. Even heliographs (signal mirrors) may be useful as they are directional, which aids security. Sound communications are usually impractical due to distance, vehicular noise, and storms, but can be used for local alarm systems.

Visual signals. Colored flags with prearranged meaning can be used as a means of communication in the flat open terrain of the desert.

Electronic Warfare. Electronic warfare is important in all environments, but is particularly important in the desert for the following reasons:

Radio systems are by far the most important means of communication and the most susceptible to jamming or monitoring. It may be more difficult to site antennas where they will efficiently cover the area of friendly forces yet will not radiate to the enemy.

Some other normal means of intelligence (civilian population or prisoners of war) are not as useful, either because of scarcity, or their information already is out of date due to the mobility and speed of the forces employed.

Electronic warfare is described in detail in FM 100-32 *Tactical Electronic Warfare.* Measures that can be taken by each level of command are described in the appropriate How-to-Fight manuals.

TACTICAL DECEPTION OPERATIONS

Large scale deception operations are normally planned by division or corps; however operations of short range and intermediate effect may be employed at brigade level, or lower, to achieve tactical advantages. Execution of large or long range operations is normally centrally controlled to ensure that efforts to deceive the enemy do not result in friendly units blundering into dummy positions, minefields, or installations especially constructed to deceive. Each individual and unit contributes to the deception effort by maximizing OPSEC to prevent alerting the enemy to our real operations.

The use of deception depends very much on timing. Sufficient time must be allowed for the deceptive information to sink through the enemy intelligence system for his maneuver units to react. Too much time, on the other hand, may allow him to see through the deception, thereby ruining the whole plan. Described below are certain deception techniques that can be used in desert warfare.

Preparation of dummy installations can conceal operational plans to deceive the enemy as to the real location of potential targets, such as POL dumps or railheads. Dummy installations should be camouflaged and protected by a few air defense weapons; otherwise the enemy will suspect that they are phoney. Flammable material, can be ignited after an attack to simulate damage. Activity can be simulated by varying locations and sizes of dummy supply stocks daily and by varying wheel tracks at intervals to simulate vehicular activity.

Damage can be simulated to induce the enemy to leave important targets alone. Ragged patterns can be painted with tar and coal dust on the walls and roof of a building and covers placed over them. Debris can be stacked nearby and any unused portions wired for demolition. *During* an attack, covers are removed under cover of smoke generators, debris scattered, and demolitions blown. Subsequent enemy air photography will disclose a building that is too badly damaged to be used. Soldiers using the building after an attack must guard against heat emissions after dark and care must be taken to control electromagnetic emissions.

Phony minefields can be used to simulate live fields. *No live mines are emplaced in a phony minefield.* The ground is disturbed so that it appears that mines have been emplaced. Boundaries are marked with appropriate warnings. No personnel or vehicles are allowed into the minefield area. A real minefield can be made to appear phony or it can be camouflaged. Once a real minefield is settled, a wheel or a specially made circular wooden tank track marker is run through a field, leaving track or tire marks to lure the enemy on to live mines. Antipersonnel mines should not be sown in such a field until the track marks have been laid. Another method is to leave gaps in a mechanically laid field, run vehicles through the gaps, and then close them with hand-laid mines without disturbing the track marks.

Decoys can be used to confuse the enemy as to the strength of friendly forces and unit identity, or to conceal unit movement by being sited in a position after the real unit has moved.

Stationary vehicles and aircraft can be erected using lumber, burlap, paint, and parts of destroyed equipment, or sophisticated flexible foam rubber models may be available. It is important that vehicle tracks are made entering or exiting decoy positions, as appropriate, to deceive photographic interpreters.

The degree of accuracy necessary depends on the range of enemy surveillance, but some metal should be used in each model to produce heat emissions in the cooler hours. It is also necessary to include a limited number of electromagnetic sources to deceive electronic support units. Models are moved at intervals so they are not in the same position on successive air photographs.

Mobile decoys serve the same purpose as stationary decoys. They have the advantage of being more lifelike and the disadvantage of requiring more labor and personnel. Mobile tank decoys constructed on support vehicles can be used to cause the enemy to believe friendly forces are attacking or withdrawing, conceal the fact that a real unit has moved, or give an exaggerated idea of tank strength. Real tanks may also be camouflaged as support vehicles.

Field artillery decoys can be constructed in the same manner as described above. Due to enemy target acquisition capabilities by flash or sound ranging, fire must also be simulated. If simulators are not available, explosive charges can be suspended between 3 and 4 feet from the ground and detonated to simulate field artillery fire. If the explosives fail to give sufficient flash or detonation, photoflash can also be used, filtered to the appropriate color. Fire should be simulated at the same time as real field artillery fire to confuse the enemy as to the location of the real firing unit.

Counterfire intelligence can also be obtained from dummy positions if the enemy returns fire. It is provided to the division artillery. Personnel manning dummy field artillery positions should have foxholes for protection against enemy counterfire.

Decoy unit positions must be sited carefully. They must not be unusually obvious and must be placed in locations where the enemy would expect to find a unit of the type being copied. Shallow fighting positions may be dug to represent infantry positions. They should be approximately 1 foot deep and filled with brush to deepen the shadow and give an illusion of depth. They must also give the impression of being camouflaged and equipped with overhead cover. Constant maintenance is necessary. As with decoy vehicles, there must be some form of activity simulation in the area.

Noise may be used to create a false impression of strength or movement, or to lure an enemy force into an area where fires can be concentrated against them. Noise is particularly effective at night, because it will carry much farther, but it is affected by wind strength and direction. Noise may be recorded; for example, a line of powerful tape recorders can easily simulate a column of tanks or helicopters on the move, but it is essential that the amplifier hum is not heard. Deliberate natural noise, for example, the clang of dropped cans or a closing tank hatch, can easily be overdone by constant repetition, possibly producing a situation quite different to that intended.

Dust. The normal dust column raised by movement can be used to an advantage. A fake helicopter landing zone, equipped with decoy aircraft, can also be made more realistic by a jeep towing chains between the "aircraft," giving the impression of aircraft hovering close to the ground. A few real aircraft flying NOE can give the impression of a great deal of activity.

SPECIAL OPERATIONS

Because of wide areas involved in desert operations, gaps can almost always be found in enemy defenses. Small units can slip through to conduct raids, to sabotage installations and pipelines, gather intelligence, and effect liaison with friendly irregular forces.

In addition to the mission, the following factors should be considered before conducting a special operation:

- Local natives, attitudes, possibilities of support (including guides), languages spoken, payment.
- Cover plan to divert suspicion from local inhabitants.
- The terrain to be covered, course to be followed to and from the objective, maps and air photographs available.
- Method of entry and exit. The return route should be as different as possible from the initial route.
- Climatic peculiarities expected.
- Size of the force.
- Air support.
- Supplies to be carried by the force, methods and locations of prestocking and resupply if any.
- Medical support.
- Special equipment and weapons.
- Communications.

Personnel for these operations should be selected with the utmost care. Officers should be Ranger qualified, experienced in different desert terrain, and able to speak the local language; if not, officers should have had considerable training in living off the land away from civilized communities. Enlisted men, to the extent practical, should be similarly qualified. Each member of the team must be a skilled driver with experience in desert terrain and an expert on all types of small arms likely to be used. A significant number of the group must be capable of operating all of its communication systems. A smaller number should be qualified in first aid and mechanics must also be included. A number of personnel must be proficient in dead reckoning and celestial navigation by day and night. All must be physically fit.

Assuming that personnel already have the technical training just described, training for special operations can be gained by journeys into total desert, held by friendly troops. A team of this type requires at least 1,000 miles of experience across unmapped featureless terrain before it will be ready to operate against the enemy in his own desert territory.

The team must be fully mounted and the number of vehicles should be kept small to minimize the probability of mechanical malfunctions and bogging down. Light, simple cargo vehicles are preferred to track armored vehicles, which are complicated to repair and use too much fuel.

Infrequently a team may be parachuted in, flown in by helicopter, or even moved by boat or submarine if the objective is near a coastline. Helicopters are not advisable for general use in special operations as they are extremely difficult to hide and use large quantities of fuel; although they have the advantage of speed.

Sufficient rations, ammunition, fuel, and water must be carried so the team can perform as a self-contained unit for the period of the operation. Each item must be weighed out to the pound, and water, due to its weight and volume, should be limited to the medical-advised minimum according to the environment. Extra water is required for radiators. All vehicles should be equally loaded. Daily consumption will lighten each truck load so limited overloading is permissible at the start, especially if the first few days of the operation are over trails or known areas. Although items may be prestocked in certain locations either before or during an operation, this should be rare because it may compromise security.

Choice of weapons to be carried will depend on the mission, but all vehicles should be armed with a vehicle- mounted machine-gun at least. Heavy and light antitank weapons and shoulder fired air defense weapons may also be included.

Radio communication will be needed between vehicles and with the force headquarters that directs the operation. Radios should be capable of operating from vehicle or dry batteries. Within the team, communications should normally be by voice, or hand, or flag signals; although flares or radio can be used in an emergency. Messages from higher headquarters should be sent on a variable frequency and time schedule and the team should not be required to reply except in extreme circumstances.

The majority of movement should be by night because it is cooler and easier to navigate. Crews can rest under their camouflaged vehicles during the day. If attacked from the air when stationary, all personnel who are not manning vehicle-mounted air defense weapons should scatter from the vehicles, which will be the main targets. If any vehicles are hit, the first priority is to remove the water supplies.

On arrival in the objective area, the maximum available time should be spent on reconnaissance; since the team must rely on surprise to achieve its mission.

COMBAT SUPPORT FOR DESERT OPERATIONS

A force operating in the desert must be capable of meeting any known or foreseen weapons system. It must be a balanced force with combat support and combat service support; it must be a combined arms team. While principles of combat support operations are found in How-to-Fight manuals dealing with a specific arm or service, there are some techniques that must be modified or emphasized in the desert.

Field Artillery.

Due to the fluid nature of desert operations and the possibilities for excellent enemy observation, it is necessary to provide close and continuous field artillery support for all levels of the force. Field artillery pieces must be at least as mobile as the force they are supporting. Crews must be proficient in direct fire and prepared to defend against a ground attack.

Due to the threat of immediate counterbattery fire, field artillery units must be prepared to move into position, fire, and rapidly displace to another position. A battery should be prepared to displace several times per day.

Field artillery units employed in desert operations should be equipped with the most sophisticated survey devices available. Manual systems are slower and not necessarily as accurate, thus affecting tactical employment and reducing response time.

Aerial observation may often be extremely difficult due to enemy air defense, so most adjustment is by ground observers. How the environment affects observation of fires is described in paragraph "Observations and Fields of Fire," page 4-4. Weather conditions can change rapidly in the morning and evening (and occasionally at other times of the day), affecting the accuracy of fires; so weather corrections must be recomputed frequently.

Air Defense Artillery.

Because of the wide open spaces characteristic of many deserts of the world and the relatively large areas associated with desert operations, forces fighting in the desert should be reinforced with more than the normal complement of air defense weapons. Even so, there still may not be sufficient dedicated air defense systems to fully cover the force. When this is the case, commanders must be especially careful when establishing air defense priorities in view of relatively long lines of communication and the tendency to maneuver over relatively large areas. In any event, all units must include a scheme for countering air attack in their battle plans. Both active and passive measures are required.

Although armored and mechanized infantry division air defense weapons are tracked, this does not necessarily apply to corps medium altitude air defense units. However, corps surface-to-air missile (SAM) units have considerably greater ranges, and are equipped with more sophisticated early warning and control systems. So, some corps units should be employed well forward. These weapons will have to displace by section to ensure continuous coverage.

Automatic weapon units have relatively limited range and require careful control of ammunition due to their high cyclic rates of fire. They are, however, extremely versatile and may be employed in direct-fire ground support roles if necessary. They are useful for employment with highly mobile forces as they can be deployed very quickly in their planned air defense role.

Air defense artillery units should be located close to elements of supported units to provide for ground defense. When the supported unit moves, the air defense unit must also move, which requires careful coordination to ensure that movement of the supported unit is not delayed.

Engineers.

Engineer operations in the desert are similar to those in temperate climates; although there are fewer natural terrain obstacles to be crossed. Depending on the terrain anticipated in the operations area, a dry-gap crossing capability may have to be obtained from corps support units. Important tasks for engineers in desert operations include:

- Finding, developing, and if necessary destroying water supplies. This is a high priority task.
- Map making.
- Construction of obstacles.
- Construction of logistic activities and routes.
- Construction of field fortifications.
- Construction of airfields and helicopter landing pads.

Development of water supplies. Water supply is the single most important mission of engineers in the desert. The search for sources requires continuous, intensive reconnaissance. Water may be obtained by drilling beds of dry water courses, or by deepening dry wells. Once found, water must be made potable and stored or transported. Since water purification trucks may be high priority targets, and barely sufficient for the task, any force operating in the desert must be augmented with water supply units, including well drilling, water purification and water distillation teams, and transportation.

Destruction or denial of water supplies. Destruction of enemy water sources can reduce his efficiency to a degree that he becomes militarily ineffective. Known sources and targets such as pipelines are priority targets for air attack. In retrograde operations, friendly water sources may be mined, booby-trapped, or contaminated (a distillation of old animal bones can be used); poison is forbidden by the Geneva Convention. Care must be exercised to ensure that no action is taken that would deny water likely to be needed by friendly forces. The political impact on the local population of water source destruction or denial must also be considered before the decision is made to do this. In any case water sources should not be destroyed without approval of higher headquarters.

Map making. Large areas of the world's deserts are not covered by maps of any useful tactical scale. The maps that exist are frequently inaccurate, increasing the difficulties of navigation. Therefore, it is necessary for engineer topographic companies to augment the force to prepare, print, and distribute up-to-date maps of the operational area. USAF and Army aviation support can be used to produce gridded maps from aerial photography of the area forward of the line of contact.

Obstacles. Due to the mobility inherent in desert operations, obstacles must be extensive and used in conjunction with each other and any natural obstacles. Isolated obstacles are bypassed easily.

Mines are easily emplaced in a sand desert, and blowing sand will effectively conceal evidence of emplacement. However, the following potential problem areas must be considered:

- Large quantities of mines are required for effectiveness.
- Sand can cause malfunctioning.
- Shifting sand can cause mine drift.
- An excessive accumulation of sand over the mines can degrade performance.
- Sand may be blown away, thus exposing the mines.

In suitable terrain, antitank ditches that exceed the vertical step of enemy main battle tanks may be used. Because antitank ditches cannot be concealed, they must be dug so they do not outline a defensive front or flank. They have the advantage of not requiring as much logistic support as mine fields. They must be covered by observation and fire to prohibit enemy infantry using them as ready-made trenches.

Construction of logistic activities and routes. Because of limited off-road mobility of most combat service support vehicles, considerable engineer effort may be necessary to construct and maintain routes forward to maneuver units. Local resources, such as ground or salt marsh mud laid on sand can be used. Track vehicles should not use these routes since they could easily tear them up.

Combat Intelligence. The relative importance of intelligence sources may vary from that expected in more conventional areas. Prisoners of war require immediate interrogation as the flexibility of operations will rapidly make their information out of date. Very few civilians are encountered in desert operations and information they give should be treated with caution unless corroborated. Military intelligence teams located in the area of operations have the ability to determine if these PWs and civilians are in fact what they say they are or infiltrators sent to harass the rear area and commit acts of sabotage. Electronic support measures are a major source of intelligence in desert warfare. Enemy activity, or the lack of it, is a good source of information; so punctual, accurate reports by all sources, both positive and negative, are necessary.

Military Police. Combat support well forward by military police will continue in desert operations, although over increasingly extended distances. Of special importance will be MP tactical and physical security over extended lines of communication such as petroleum pipelines and viaducts transporting water over long distances. The criticalness of these items demands both active and passive measures, including overflight by returning aircraft or overwatch by convoy movements. The storage sights for water, food, POL and ammunition have historically been principal targets for enemy action, and consequently must receive augmented security. The indefinite conditions and number of roadways will require increased circulation control points to direct traffic, redirect stragglers, and provide information so that throughput forward to the fighting elements will be expedited.

Military police are especially valuable when the combat commander must employ concentration/economy of force in the face of the enemy to gain a favorable combat ratio. MP's can secure the roadways, enforce priority movement, and prevent any delay of the elements undertaking passage of lines to blocking or defensive positions.

US Air Force Support.

A US Army force fighting in the desert can expect to be supported by USAF tactical fighter bomber and airlift aircraft. Close air support by USAF tactical fighter bombers is most important in desert warfare in view of lack of concealment, relatively large areas of operations, and mobility of forces employed by each side. It is easier to locate targets; visual observation is normally far superior to that in temperate climates; and ground movement more readily apparent. Air attacks may be handicapped by lack of covered approaches, but increased visibility permits engagement from standoff ranges. When flying close air support missions it is important for pilots to be able to differentiate between enemy and friendly forces. Panels or other visual or electronic identification means must be used to assist in identification.

Because of extended lines of communication likely in desert operations, USAF theatre tactical airlift should be used whenever possible. This is particularly true of resupply operations conducted from a lodgement area to forward trains areas when considerable distances are involved.

Planning for air support must be as detailed as time permits to determine mission and armament requirements, time over target, and method of control. The joint air-ground operations system (AGOS) used to request and coordinate the use of US Air Force tactical air support is described in FM 100-26, *The Air-Ground System.*

US Navy Support.

When the force is being supported by US Navy gunfire, or Navy or Marine aircraft, elements of a Marine air and naval gunfire liaison company (ANGLICO) are attached to Army ground forces. The mission of the company is to support an Army division by providing control and liaison agencies for the employment of this support.

Platoons and teams can advise commanders on capabilities, limitations, and employment of naval gunfire and USN or USMC air support. Platoons are normally placed with brigades or higher headquarters, with air and gunfire support teams placed with battalion task forces. Although the company has organic vehicles and some combat service support capability, its elements generally require some additional administrative and logistic assistance from the supported unit. In order to net with Army units, additional communications equipment may also have to be provided. Additional information on ANGLICO employment can be found in FM 31-12, *Army Forces in Amphibious Operations.*

COMBAT SERVICE SUPPORT

Combat service support for desert operations is described in detail in chapter 5. When planning a desert operation it is necessary to consider the following factors:

Because of distances between units, speed of supply may be slowed and lines of communication can be vulnerable. Except for class V and sometimes class III, resupply should be at night for reasons of security.

Great demand for water can tie down quantities of transport and may involve laying pipelines. Water is vital, so every operation estimate must consider the water situation.

Increased maintenance is required due to heat, sand, and dust damage to equipment. This not only increases the repair workload, but also increases demand for replacement items due to increased wear.

Supply. The essential mobility and freedom of tactical maneuver are totally tied to the ability of the logistic chain to supply maneuver units. Two alternatives are available: increase the rate of supply, probably requiring more vehicles, or prestock, which ties units to the stocked area. Some important supply considerations are:

- *Class I.* It is often impractical to supply hot rations from mess trucks, especially when the unit is subject to enemy air reconnaissance or target acquistion devices. Crew feeding from canned combat rations is the usual method of troop feeding.
- *Class III.* Daily requirements for POL in desert operations can be expected to be high. Estimates for POL requirements should take into consideration large scale maneuver inherent in desert operations.
- *Class V.* Estimates of ammunition requirements should reflect the heavy level of commitment that can be anticipated in desert operations.

Maintenance. Disabled vehicles are vulnerable targets. Both they and the maintenance vehicles used in working on them must be concealed during the day and strict light and sound discipline imposed at night. Maintenance contact teams carrying class IX supplies that have a quick turnover should be used.

Evacuation of Sick and Wounded. Although medical evacuation is similar to that in other areas, it is complicated by long and limited routes and the absence of facilities, water for example, along them. For these reasons, evacuation by helicopter is preferred. Medical units and evacuation vehicles will require greater quantities of intravenous fluids than would be carried in temperate zone operations.

COMMAND AND CONTROL

The commander controls operations, using a highly mobile command group located well forward. He personally directs the battle, but must not be drawn into personally commanding an isolated segment of the force to the detriment of the remainder of the command.

As previously mentioned, dry desert conditions can sometimes reduce radio signal strength and create unforeseen blind spots, even in aircraft operating nap of the earth. If there is any possibility of a commander losing contact with some elements of his command for any length of time, he should operate where contact can be maintained, at least with forward units in critical spots and with his tactical operations center.

THE ENEMY IN DESERT OPERATIONS

Enemy forces operating in the desert are predominantly armored, featuring large numbers of tanks, infantry armored fighting vehicles, self-propelled field artillery and air defense artillery, and other mobile supporting forces.

Enemy forces are equipped with a complete array of individual and vehicular protective gear for operations in an NBC environment. Most armored vehicles feature positive protection for vehicle crews when closed down. Enemy forces train extensively for operations on a nuclear battlefield.

Enemy forces are well equipped to conduct effective electronic warfare operations, including radio interception, jamming, direction finding, and countermeasures to systems similar to their own.

Threat force equipment and tactics are described in How-to-Fight manuals appropriate to each level of command. The following paragraphs describe enemy tactics in the desert.

HOW THE ENEMY ATTACKS

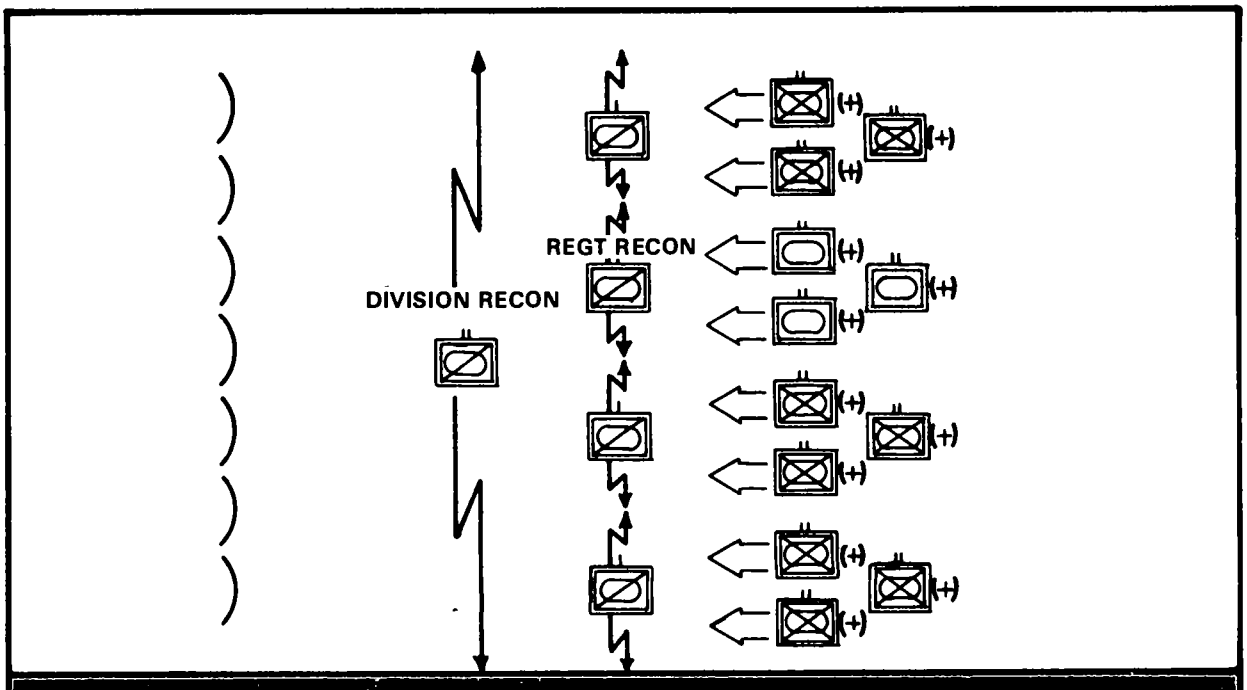
The enemy avoids frontal attacks in the desert; although he will do so if it will enable him to hold a defending unit in place while other units maneuver to take advantage of an uncovered flank or gap. He will most often try to attack from one or both flanks, or from the rear. Objectives are deeper than in more conventional terrain and may be airfields, mountain passes, water points, or other key features. Frequently ground forces attack to link up with parachute or airmobile troops that have completed such missions. Ground forces also attack to cut main supply routes or, destroy combat service support installations.

Attacks are conducted on a wide front. There may be gaps between companies of a battalion, battalions of a regiment, and regiments of a division. A division may attack in a single echelon; although each regiment may maintain a company in combined arms reserve. When a motorized rifle division attacks in two echelons, the tank regiment is likely to be in the first echelon. Regiments and battalions are given more freedom to maneuver than normal.

Speed is emphasized. The enemy frequently uses smoke, including dummy screens, to confuse the defender as to the actual direction of his attack. Movement will frequently be at night using active and passive night vision devices. Some vehicles are equipped with gyro compasses for navigation. Formations depending on them will vary their direction of movement as little as possible so as to not become disoriented.

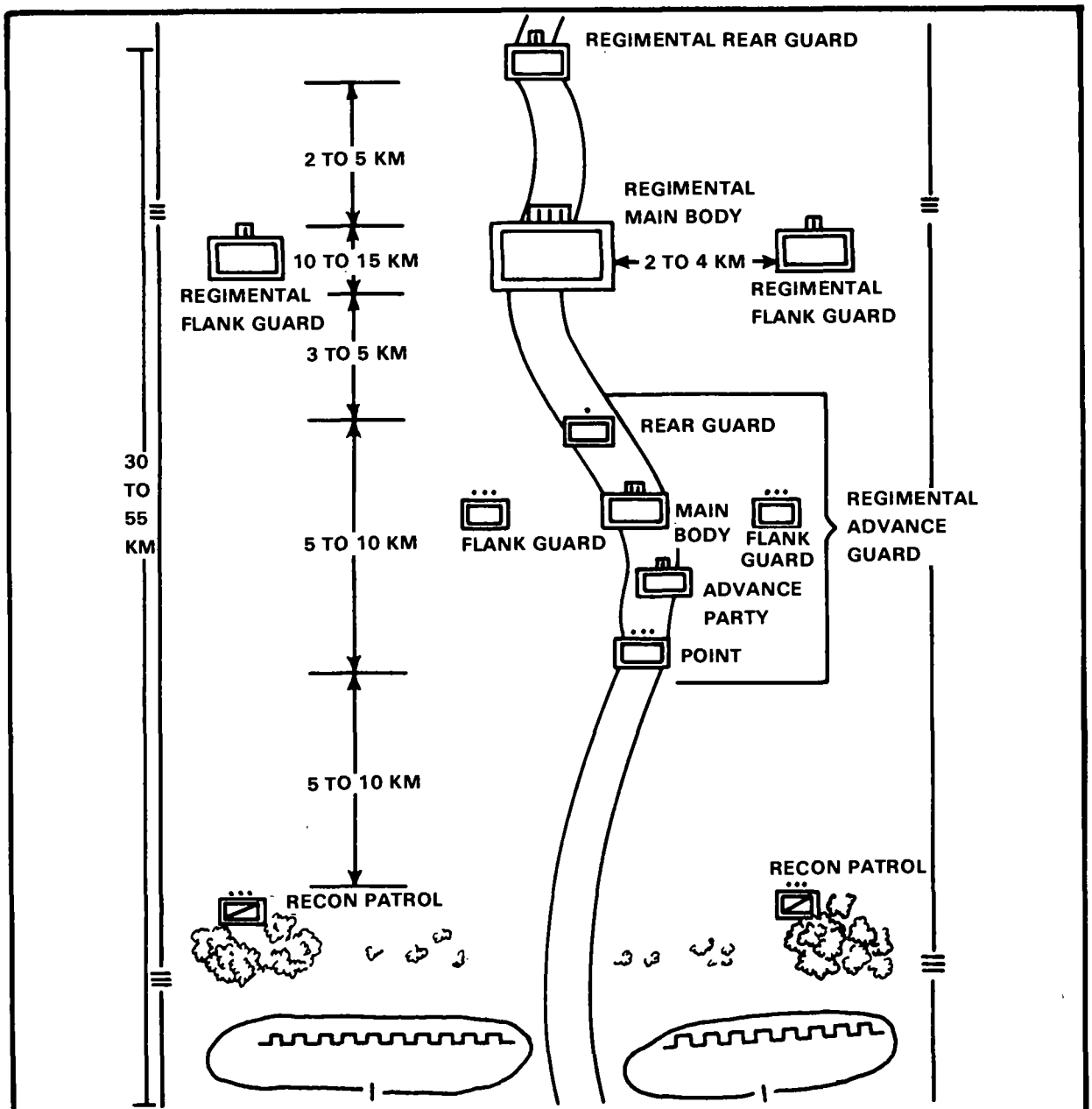
Infantry may infiltrate dismounted to achieve surprise, with tanks and infantry carriers providing a base of fire, joining them after the attack has started.

Combined arms teams are as logistically self-sufficient as possible, especially for water.



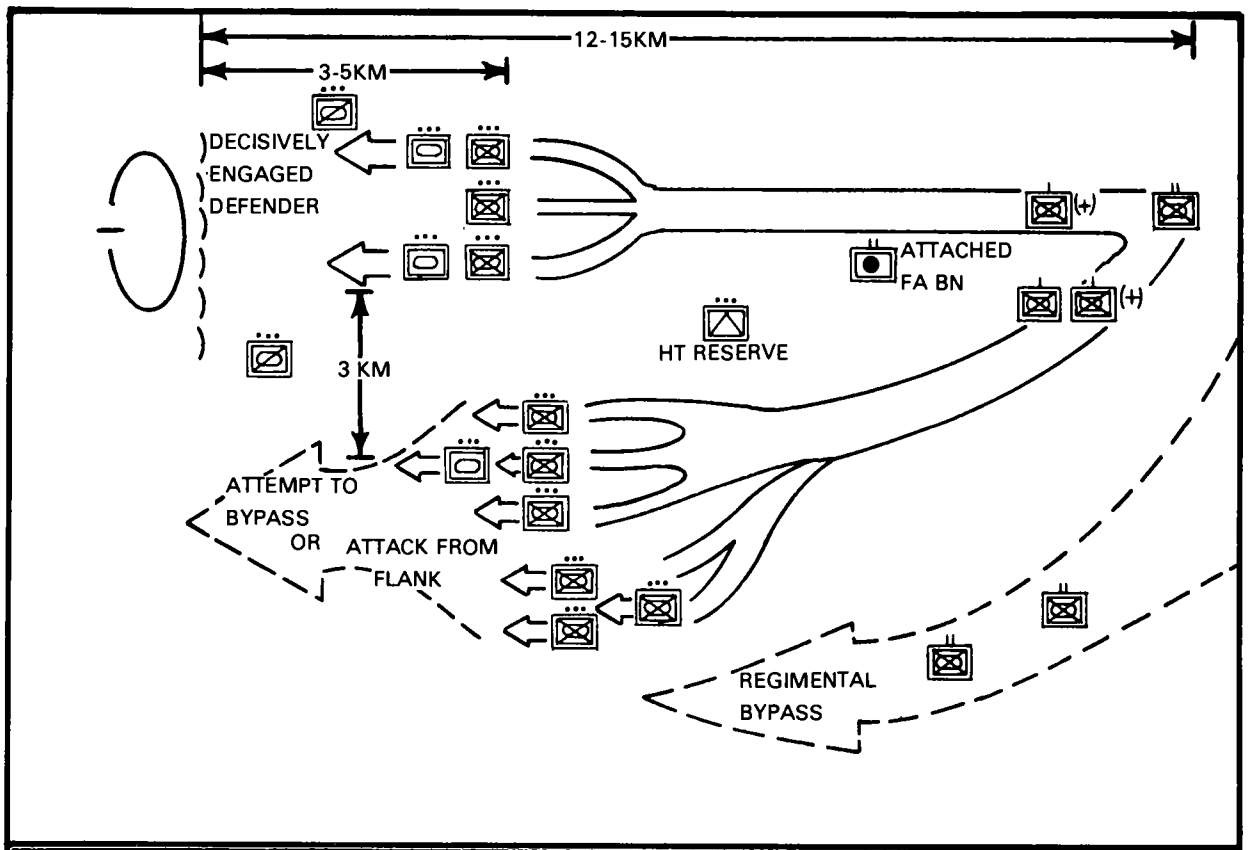
THREAT DIVISION FRONTAL ATTACK.

Meeting Engagement. Enemy forces expect meeting engagements, following a movement to contact, to be most often decisive in desert warfare. An enemy regiment moving to contact is shown in the following example.



THREAT REGIMENT MOVING TO CONTACT

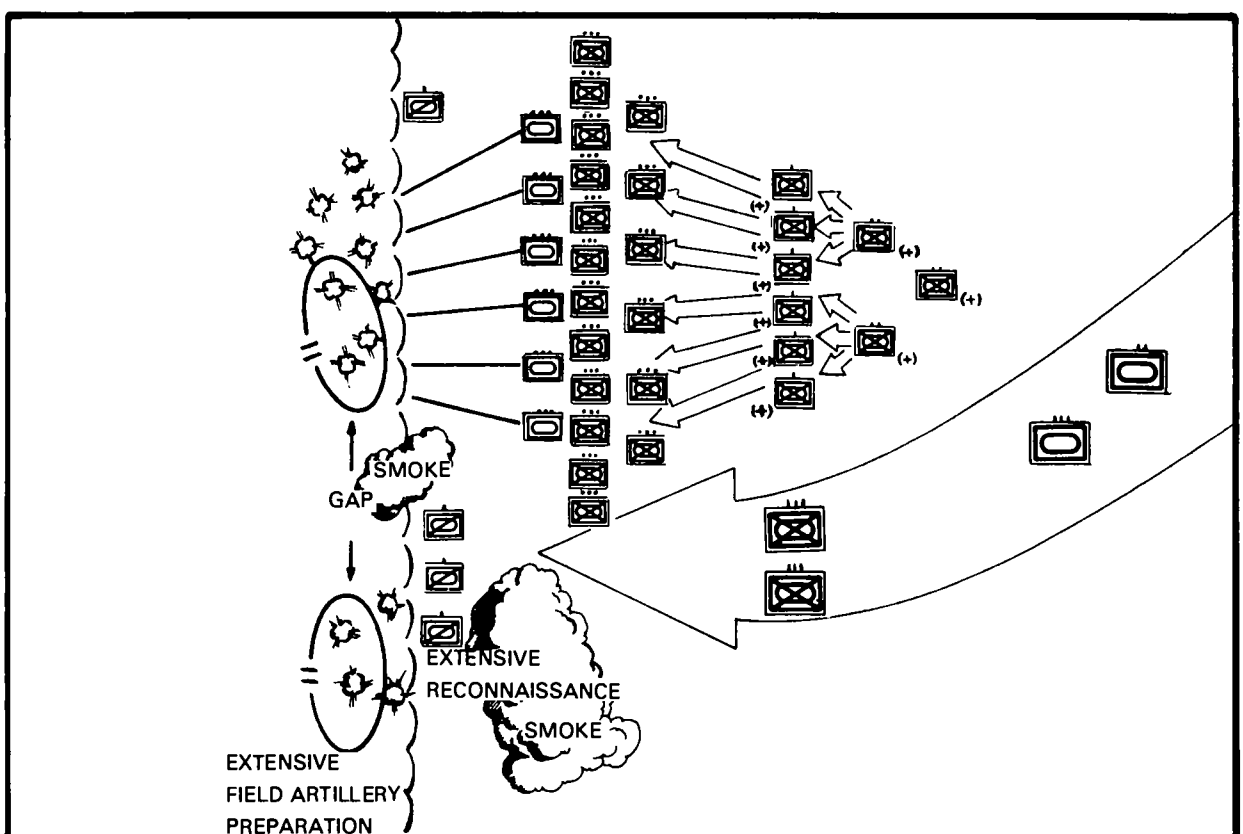
Meeting engagements are planned against resistance met during movement; while breakthrough attacks are used against forces that cannot be defeated directly after contact is made. A battalion moves in column until division and regimental reconnaissance locate the enemy. Due to longer observation and fields of fire of the defending force, the battalion deploys into company columns approximately 12-15 kilometers from the defenders, and into platoon columns 3-5 kilometers from the line of expected contact. The forward company engages the defenders to pin them down, and provides supporting fires while the remainder of the battalion moves out to one flank or the other, and either attacks the defenders from that flank or bypasses the position. This maneuver may be up to 3 kilometers from the original avenue of approach. If the battalion cannot outflank the defense, it continues to maintain frontal pressure while the remainder of the regiment extends the flanking maneuver. Such movements are covered by antitank reserves, regimental mine-laying detachments, smoke, and possibly attack helicopters to reduce the risk of counterattack. When the lead regiment is committed, the division artillery group, deploys in support.



THREAT REGIMENT HASTY ATTACK

Breakthrough. The breakthrough is mounted against well prepared enemy positions or when a meeting engagement has been repulsed. It is also used by a regiment to engage a defender while the remainder of the division maneuvers to attack from the flank or rear. The breakthrough involves larger forces, takes longer to prepare, and has a greater weight of fires than a meeting engagement.

Since previous reconnaissance had been unable to locate gaps or weak points in the defensive positions, the reconnaissance effort will be oriented to gain the maximum amount of information concerning the breakthrough area, including artillery locating systems, radar, and radio intercept systems. The attacker normally chooses an avenue of approach with best trafficability and ease of navigation. When two avenues exist, a major effort is made along one. Units on the other conduct a supporting attack at a time that diverts attention from the main effort. Each avenue used by a division is normally 4-10 kilometers wide, depending on available artillery, with 2 regiments on one and 1 regiment on the other. The forces on the main avenue may be supported by massive artillery, including mortars, multiple rocket launchers, antitank guns, and indirect tank fire (where necessary) for up to 100 tubes/km of breakthrough frontage.



THREAT DIVISION DELIBERATE ATTACK

Divisions normally have assembly areas about 20-30 kilometers from attack positions. Units normally move forward from dispersed areas in march column breaking into company and platoon columns at the same distances as would be used for a hasty attack. Heavy artillery preparatory fires will start at approximately y the same time as battalions break into company column and normally last between 25 and 50 minutes. Nuclear or chemical strikes, if used, are made immediately before conventional preparatory fires.

Tanks usually lead the assault, with infantry carriers 100-400 meters behind, supporting them with main or secondary armament. Infantry are unlikely to dismount unless resistance is exceptionally strong. Mine plows and rollers are used if necessary, with platoons moving through minefields in column. When obstacles cannot be cleared mechanically, the infantry may be forced to dismount along with supporting engineers, to clear lanes for armored vehicles.

The second echelon, if any, is committed to maintain pressure on the main avenue of approach when the momentum of the attack slows. As soon as it makes contact, a combined arms reserve is formed from bypassed first echelon units, while the remainder of the first echelon if still effective continues to advance. A unit that has successfully broken through the defense often moves ahead of its parent unit to destroy deeper positions or seize deeper objectives. Such tasks are often undertaken in conjunction with airborne or airtransported troops.

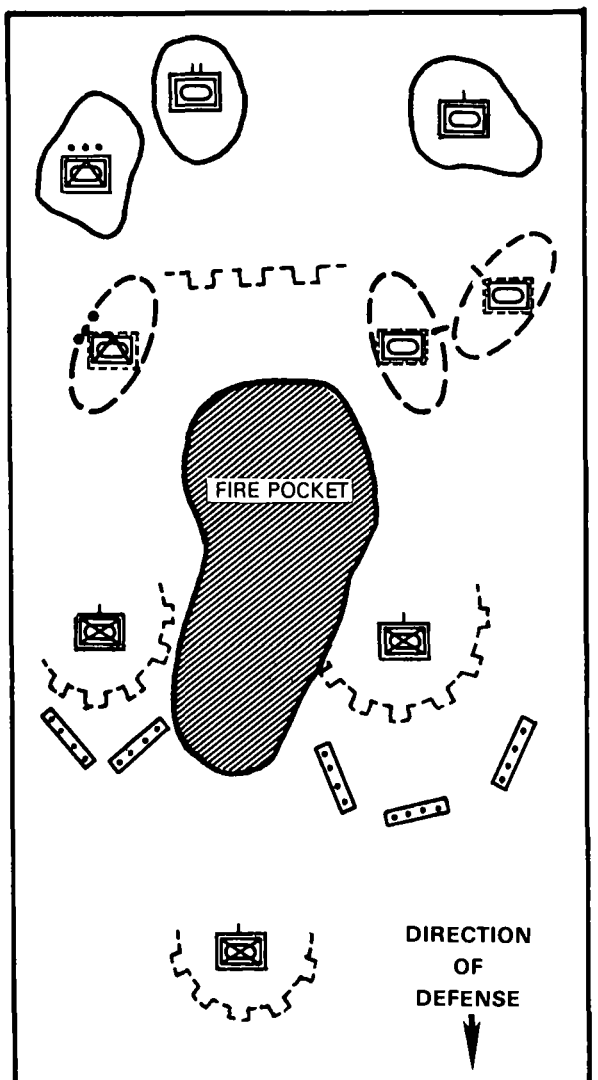
Parachute and Heliborne Operations. Airborne and airtransported troops are used extensively, especially at night. Airborne troops are not often committed within brigade area except in support of nuclear strikes. They are usually used on much deeper objectives, for example, a lodgement area. Operations by airtransported troops, using HIP and HOOK and supported by HIND-A attack helicopters, are frequent. The normal force used on such operations is a battalion, or occasionally a larger unit, from a second echelon motorized rifle regiment. A motorized rifle battalion is usually transported with its organic vehicles and mortars. Likely missions are destruction of critical installations, securing water sources, blocking movement of reserves, destroying command posts, and seizing defiles. Helicopters, in flat desert terrain, are vulnerable if in range of ground defenders so they may make a wide detour around a flank. Ground forces attack in order to link up within 48 hours after the operation starts. Until linkup occurs, fire support for the force is normally limited to 120mm mortars, MRLs, ATGM attack aircraft, and possibly a reinforcing artillery battery (towed 122mm).

Pursuit. If the enemy observes any indication of retrograde operations, or attempts to disengage, he maintains pressure and takes up pursuit without further orders. The object of pursuit operations is to encircle and destroy opposing forces. Pursuit operations are conducted by regimental or larger units. Specially tailored units may be organized for pursuit operations. Pursuing forces try to prevent consolidation along defensive lines, block movement of reserves, seize water sources and any chokepoints along routes, and force retrograding units to halt and deploy.

The enemy moves on axes parallel to the retrograding force, staying as close as possible so as to maintain continuous observation, and allow simultaneous attack from march column to destroy the retrograding force.

Pressure against opposing forces is maintained by motorized rifle units while tank units in march column move on parallel routes. Air transported troops and advance units, such as a motorized rifle division's

independent tank battalion operate up to 60 kilometers ahead of the main body. Units on these missions, however, have only limited endurance and the tank battalion in particular usually avoids becoming involved in sustained combat until it reaches its designated objective. Fresh units are passed through others to maintain momentum.



THREAT REINFORCED MOTORIZED RIFLE BATTALION IN HASTY DEFENSE

HOW THE ENEMY DEFENDS

The enemy uses defense as a temporary measure. When necessary, he holds terrain with motorized rifle troops well dug-in, supported by ATGMs and tanks. Reserve tank units are used to block and counterattack penetrations. Roving guns and batteries are often employed by supporting field artillery.

Hasty Defense. The enemy conducts a hasty defense when consolidating on a line, protecting the flanks of an advancing division, or when unable to continue to advance. Hasty defense is an expedient employed only until second echelon forces can be deployed to continue the attack.

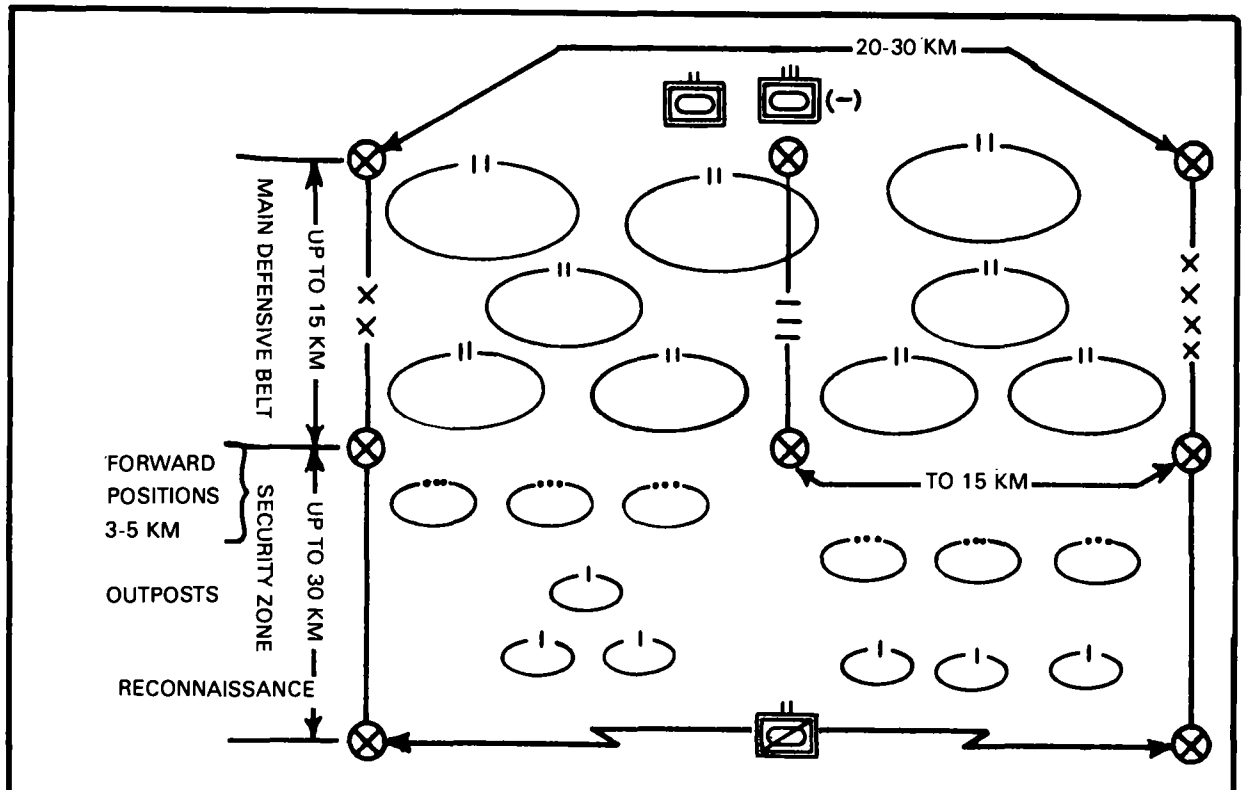
Troops dig in quickly to establish company-size strongpoints. All antiarmor equipment, such as "suitcase" Saggers and RPG-7s are brought forward. BMPs remain near their platoons. Tanks are withdrawn to positions where they can be hull down, or where they can form a counterattack force. The regimental air defense battery immediately deploys, usually with SA-9s in the area of the regimental TOC and trains, and ZSU-23-4s roving. Priority is given to field artillery fire plans, including direct-fire antitank fires.

The disposition of companies depends on the importance of the battalion sector and local obstacles. It is normal to find 2 companies forward with 1 company in reserve in greater depth than usual when flanks of a battalion position can be protected by natural obstacles, such as salt marshes. When necessary, all 3 companies may be forward, with a small reserve of perhaps 1 motorized rifle platoon and a tank platoon. ATGM's cover large intervals between companies and battalions. Antitank fire will be planned as far out as possible on either battalion flank.

Deliberate Defense. A deliberate defense is conducted when it is evident that the attack cannot continue for several hours, or when offensive operations are halted by higher headquarters. When time permits, the enemy will organize his defense into a security zone and a main defense belt. If unable to do this, he, simply defends from a main defense belt.

A security zone extends forward of the main defense belt as much as 20-30 kilometers or more. Normally, units from the division second echelon regiment are employed in outposts in the security zone, along with reconnaissance and combat forces from army to force an attacker to halt, or to delay him by forcing him to deploy before reaching the main defense belt.

The main defense belt is organized to stop and destroy attacking forces. A division usually defends a zone about 20-30 kilometers wide and 20-30 kilometers deep, or sometimes deeper. The defense is organized in 2 echelons with 2 regiments in the first echelon and 1 in the second echelon. The first echelon regiments defend the forward 8 to 10 kilometers of the division's zone. A series of forward positions consisting of platoons from the battalions which are in position in the rear of the regiment's area of operations are placed 3 to 5 kilometers forward of the main defensive positions. These forward positions are employed in a similar manner to the outpost line and withdraw to positions in the main defensive belt. The second echelon regiment organizes three battalion defense areas across the rear of the division's zone. These



THREAT DIVISION DELIBERATE DEFENSE

are occupied reinforced battalions. About a platoon per company and possibly a company per battalion may be retained in reserve. Combined arms reserves include a number of tanks for counterattacks and an antitank reserve to block any penetration. This reserve may consist of the tank regiment minus any battalions that are reinforcing the motorized rifle regiments and the divisional separate tank battalion. Within a motorized rifle division, for example, the reserves may consist of the entire tank regiment and the divisional 100mm antitank gun battalion.

A battalion front varies from 5,000 to 7,500 meters. Company strongpoints, or platoon strongpoints within company areas, are used if the battalion has to cover a wide front. Two and sometimes 3 platoons are placed in forward positions 2,000 meters in front of first echelon companies on the most dangerous avenues of approach. Their mission is to deceive the attacker and cause him to deploy. Forward positions normally withdraw if it is likely that they will be encircled.

Gaps between companies, battalions, regiments, and divisions may appear. Any gaps are kept under observation by patrols and ambush parties during the day and by observation posts at night. Alternate direct-fire weapons positions are prepared to cover gaps and they are also covered by direct fire.

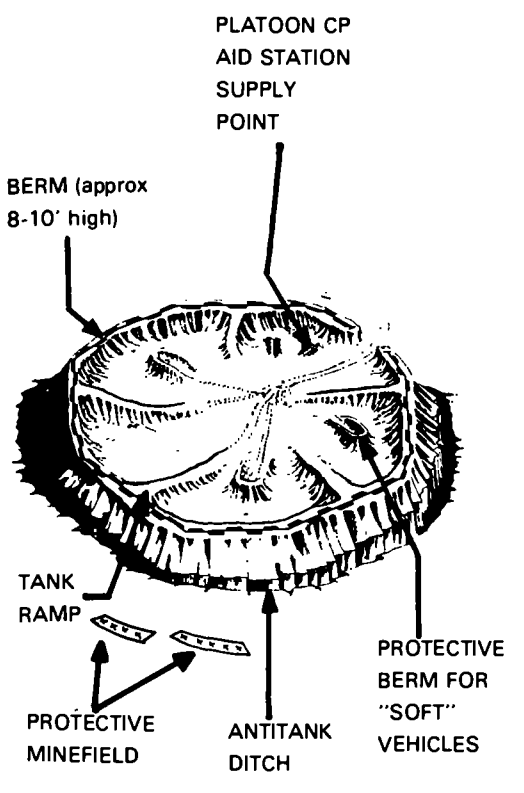
Extra field artillery is provided to a division from army, giving a minimum of four 18-gun battalions of either 122mm howitzer, D-30 or 152mm gun howitzers, D-1, or the 122mm SP or 152mm SP artillery pieces. At least one field artillery battalion is provided to each regiment and positioned well forward. As in the hasty defense, field artillery also has a direct-fire antitank mission. Reinforcing air defense artillery is positioned to establish an envelope stretching 20 kilometers forward of the line of contact.

Regimental minelaying teams, supported by division minelayers, emplace minefields to protect company strongpoints and canalize enemy armor into fire pockets. They can lay approximately 500 meters of minefield per hour, with a density of 500-1,000 mines per kilometer. Minefields are covered by antitank weapons and can be rigged for arming or detonating by remote control. Dummy positions are also used.

The attacker approaching the main position will be engaged by indirect artillery at extended ranges; Sagger's and antitank guns at 3,000 meters; tanks and direct-fire artillery at 2,000 meters and less; SPG-9s at 1,000 meters; BMP main guns at 800 meters and by RPG-7s and other infantry weapons at 600 meters or less.

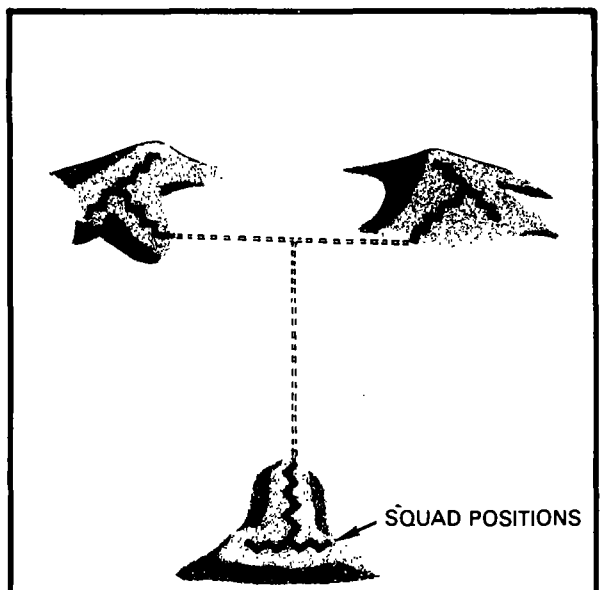
The enemy emphasizes defense at night and during limited visibility such as sand storms. Motorized rifle companies move to alternate positions after EENT as a deception measure, and tanks and infantry carriers protected by infantry squads, move forward and to the flanks to ambush, and to cover intervals between units. Observation posts are used to detect the attacker's active light sources and white light is used freely once an attack has started.

Strongpoints. Strongpoints may be encountered not only as part of a deliberate defense, but also as protection for vital installations or key terrain features such as passes, important communication centers, etc. The type strongpoint likely to be encountered by US forces operating in deserts will undoubtedly vary from locale to locale. One example of a platoon-size strongpoint likely to be found in deserts of the Middle East is shown here.



THREAT PLATOON STRONGPOINT

Another configuration for a platoon-size strongpoint is:



THREAT PLATOON STRONGPOINT

A strongpoint should normally be expected to contain antitank weapons and be well protected by minefields and antitank ditches. The combination of minefield, antitank ditch, and high berm results in a nearly tank-proof position. Furthermore, if the trenches have been dug-in well enough, it may be able to withstand high concentrations of artillery fire. If such strongpoints cannot be bypassed or if it is absolutely necessary to capture the position, it may have to be taken by a dismounted infantry assault. (See "Attack Examples," page 4-60.)

OFFENSIVE OPERATIONS

Before reading this section and the following section, "Defensive Operations," the reader must be familiar with:

FM 100-5, Operations.

FM 71-100, Brigade and Division Operations (Mechanized and Armor).

FM 71-1, Tank and Mechanized Infantry Company Team.

FM 71-2, Tank and Mechanized Infantry Battalion Task Force.

and other How-to-Fight manuals associated with particular type units. The following material discusses offense and defense as modified by desert terrain.

As in all other environments, the purpose of the attack in desert terrain is to destroy the enemy. Destruction of the enemy can be accomplished by concentrating friendly forces at a weak point in the enemy defense and destroying enemy combat units, or by driving deep into the enemy rear to destroy his combat service support and cut his lines of communication. No force can survive for long in the desert without combat service support.

An imaginative commander is not bound by terrain constraints in seeking and destroying the enemy. Due to the scarcity of key terrain in desert, normally the only constraints placed upon a maneuvering force will be its ability to maintain responsive combat service support and to protect its combat service support from enemy attack. The longer the lines of communication become, the more susceptible they are to being cut.

In most deserts, the scarcity of large areas of defensible terrain means that an enemy force has at least one flank open to attack. The attacking force must seek this flank and attempt to maneuver around it into the enemy rear before the enemy can react and block the envelopement with mobile reserves.

Successful offensive operations depend on rapid, responsive, and violent maneuver, seeking a vulnerable enemy flank and exposing none to the enemy. The enemy, realizing the danger of remaining stationary in this terrain, may choose to defend by attacking. The resulting meeting engagement between two attacking forces will often be a series of flanking actions and reactions with success going to the one who can find the other's unguarded flank first.

Units of an attacking force may conduct or participate in any one of the following types of offensive operations:

Movement to Contact.

The Hasty or Deliberate Attack.

Exploitation or Pursuit.

Within a division, lead elements of forward units, may be conducting a deliberate attack on an enemy weak point or flank to open a gap for following units to move through and exploit success. Lead units of the exploiting force will be conducting a movement to contact and hasty attacks to overcome pockets of enemy resistance. Regardless of type of operation being conducted, attacking units use the fundamentals for offensive operations described in FM 100-5, modified to suit the terrain.

FUNDAMENTALS OF OFFENSE

See the battlefield. The attacker must conduct active and aggressive reconnaissance to the front, flanks, and rear, not only to locate and identify enemy obstacles, units, weak points, and flanks but also to give early warning of threats to its own flanks and

combat service support elements. A moving force is at a disadvantage in desert due to lack of concealment. Therefore, it is necessary to push reconnaissance units as far out from the main body as possible to allow early warning and to deny the enemy close-in observation. Information gathered by this reconnaissance must be passed promptly to all units. In desert, a negative report may be as important as an enemy sighting. Commanders and staffs must avoid the two extremes of passing too little information or overwhelming their subordinates with useless trivia. Similarly, reconnaissance units must also avoid extremes. There is a very real possibility that extensive reconnaissance in one area will alert the enemy of intended operations in that area. Therefore, the need for reconnaissance must be tempered with the need for deception. In fact, reconnaissance may even serve as a deceptive measure to draw the enemy's attention away from the real objective or area of operations.

Concentrate overwhelming combat power. Mass is acheived in both time and space. Units must be able to rapidly concentrate at a given time and place, and then disperse just as rapidly to avoid offering a lucrative target to the enemy. Concentration does not necessarily mean that vehicles and men are massed in a small area of ground, but that units have the ability to place an overwhelming weight of fires on the enemy.

Mutual support is as important as in temperate climates. Due to large distances covered by maneuver in the desert, mutual support does not mean that any one unit is always in position to fire against an enemy threatening another. However, units must be capable of maneuvering in support of one another without disrupting the scheme of maneuver.

Concentration requires movement, and possibly weakening of forces facing the enemy in another part of the zone. Due to the enemy's observation capabilities, movement should take place at night or in conditions of limited visibility whenever possible. All units must be equipped, trained, and experienced in these conditions to the extent that they consider it more normal than movement in daylight. Deception measures play an important part in concentration, either to mislead the enemy as to the strength of opposing forces, or to conceal true intentions and avenues of approach. In this environment of negligible concealment, deception cannot be overemphasized.

Suppress enemy defensive fires. The enemy's objective is to stop and destroy the attacking force by direct and indirect fires, obstacles, and counterattacks. The attacker must in turn suppress enemy weapons and surveillance systems to degrade their effect and intelligence gathering capability.

Attack helicopters and high performance aircraft are extremely useful due to their ability to maneuver and apply firepower over a large battlefield in a short time. So, suppression of enemy air defense has a high priority during offensive operations. The shock potential of armor in deserts is such that destruction of enemy antitank means must also have a high priority. No target that has a long range antitank capability should be disregarded. Good gunnery and well-planned fire distribution are most important.

Shock, overwhelm, and destroy the enemy. In featureless desert terrain, the requirement to shock, overwhelm, and destroy the enemy demands *accurate reconnaissance* to tell true positions from false, and excellent *navigation* so that a commander may be certain of the deployment of his forces. Reconnoiter to find a gap or assailable flank (without alerting the enemy that the area is being reconnoitered) and concentrate to go through or around it with suppressive fires on the flank(s). A gap must be wide enough to allow one unit to bypass another that is stalled. Obstacles are likely to be placed so that attempts to go around them will often lead the attacker into a fire pocket. Equipment capable of breaching obstacles must be located well forward.

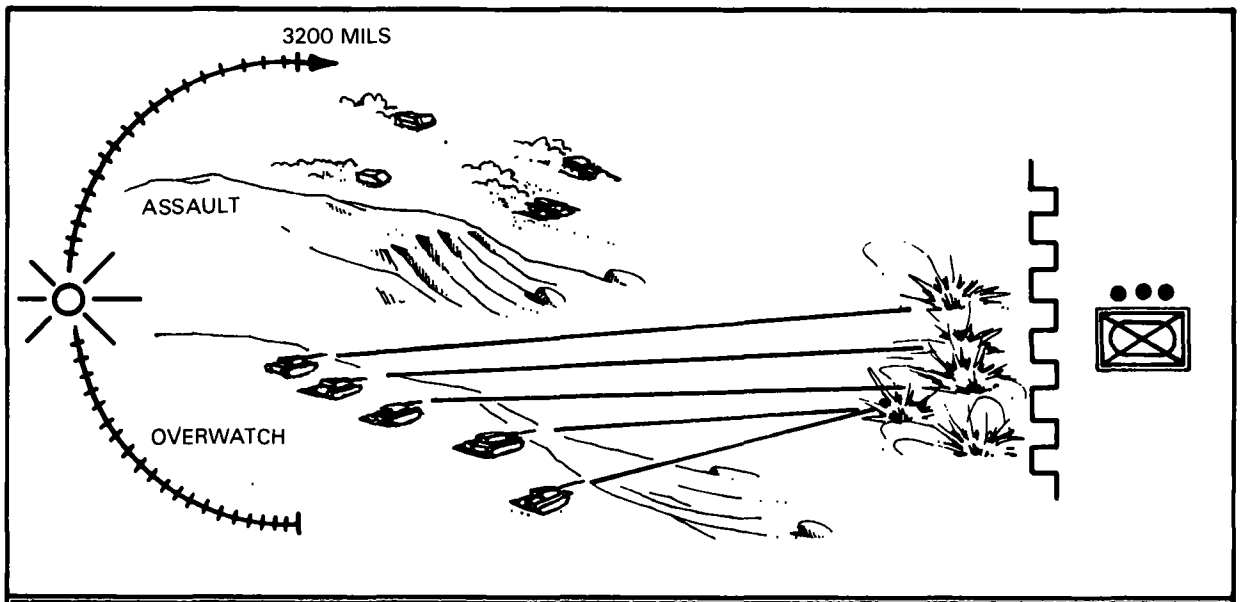
Lack of concealment means that movement of large forces is almost impossible to hide.

Therefore, once an attack has been initiated, the attacker must move as *rapidly* and *violently* as possible to retain the initiative and momentum, and to give the enemy as little time as possible to react.

Attack the enemy rear. This is the essence of operations in desert. Due to the importance of combat service support, attacking the rear will be more immediately effective at lower levels of command than could be expected in temperate climates. In the case of water, for example, the enemy *must* be able to obtain resupply. Degradation of his trains places him in a situation where his troops must maneuver against the attacker regardless of the planned scheme of defense.

Provide continuous mobile support. Combat service support must be reliable and timely, using vehicles that can travel over difficult terrain to reach positions of combat units. In the desert, more than anywhere else, the commander must ensure that he has support that is capable of maintaining his unit for a specified period of time, even if the logistic line of communication is temporarily broken.

ENVIRONMENTAL CONSIDERATIONS



ATTACK FROM THE SUN

Observation.

Light. As a general rule, a force attacking in daylight should try to have the sun comparatively low and behind it. Enemy targets can be seen plainly without the effects of their shadows, while the defenders are handicapped by glare, mirages, and haze. It is not always possible for the sun to be directly behind the attackers and it is not essential. To rely on this leads to a stereotyped method of attack, which would become known to the defenders. The commander of a maneuver force should attempt to keep the sun somewhere on a 3,200-mil arc to his flanks or rear, giving a wide choice of angle of attack.

Dust. Dust is an observation hazard to a maneuvering force, especially in situations of little or no wind. Teams should move in echelon with overwatching elements on the upwind side, and it is necessary for observers

and attack helicopters to operate well to the flank. Since it is impossible to disguise daylight movement, the assault should be as rapid as possible to minimize enemy reaction time.

Haze and mirages. In certain circumstances equipment or positions that are camouflaged and are less than 1 meter from the ground are invisible to an observer at the same height out to approximately 2,000 meters. At the same time, mirages allow observation of objects below the horizon; although these may be distorted, enlarged, or fuzzy to the point of being unrecognizable. These effects often depend entirely on the angle of the sun to the observer and are best combated by:

Maintaining observers as high above the desert floor as possible, even if only in tanks hull-down behind the tops of sand dunes.

Observation over a wide area by vehicle crews. This may allow a vehicle on one side of a position to warn one on the other side of a possible threat to his front.

Darkness. Many offensive operations take place at night. Observation in these conditions varies according to the amount of ambient light. During nights when the moon is full or almost full, the clear desert sky and ample ambient light allow good observation, both with the naked eye and with night observation devices. Maneuvering units using night vision devices must continually scan the surrounding terrain to pick up enemy activity that would be acquired by peripheral vision in daylight.

When there is no moon or very little moon, the desert night is extremely dark. Under these conditions, passive vision devices, with the exception of thermal imagery, are of little value unless artificial light is used. Reliance will have to be placed on active light sources. Employment of artificial light must be strictly controlled by the headquarters directing the operation, to maintain surprise. As a general rule, direct-fire weapons should not illuminate their target themselves, as their vision will be obscured by debris kickup by muzzle blast. Following contact, when some targets should be on fire, passive devices can be used.

Control.

Navigation. Lack of clearly defined terrain features complicates navigation and phased operations. Units conducting an enveloping maneuver are liable to lose direction unless routes have been reconnoitered carefully by the maximum number of leaders. Unit navigators may be employed; although they will be unable to control direction at night unless permitted to use radio. Routes should be marked with insignificant objects (such as small rock piles), and GSR sections should be employed to confirm locations.

Sand storms. Attacking forces must avoid being caught in unexpected sandstorms. Movement through a sand storm will depend on the unit's distance from the enemy, trafficability, the presence of minefields, and the direction and density of the storm. If the advancing unit is caught in a storm blowing from the enemy, the safest alternative is to halt until the storm abates. Since the enemy will regain observation before the attacker in this situation, suppressive fires should begin on his positions as the storm lifts. In other

situations it may be possible for platoons to form close column, using tail lights *only*, and continue movement. When the storm is blowing towards the enemy, it is possible and extremely effective, to conduct an attack immediately behind the storm.

Fires.

Fires are planned as in temperate climates on any available terrain features. When there are no significant terrain features along a route of advance, targets are planned using coordinates.

A moving force in a desert is at a disadvantage in comparison with a stationary unit due to lack of concealment and the presence of dust clouds. The defender may engage with missiles from an unexpected direction or from terrain features of no apparent significance. The attacker must be prepared to rapidly shift fires to suppress unforeseen targets. Tactical aircraft may be used to suppress or destroy targets. Targets for aircraft can be marked with indirect- or direct-fire smoke. White phosphorus or illuminating rounds set for low air burst are also effective.

Maneuver. If *terrain* permits masking of maneuvering units and trafficability is good, normal fundamentals of fire and maneuver are used. Trafficability may be restricted by rocky terrain as in the Golan Heights, or the ground may be so flat that the defender has total observation of the area. Movement in these circumstances requires speed of maneuver, deception, and considerable suppression to degrade enemy observation and fires. Frontal attacks should be avoided, especially in conditions of restricted trafficability. It is preferable to maintain pressure on enemy units in unfavorable terrain, while other forces find enemy weakness in terrain more favorable for an attack.

Tactical Deception. Deception plays a key part in offensive operations. Deception is divided into two parts: the first objective is to weaken the local defense by drawing reserves to another part of the battlefield. This may be done by making a small force seem larger than it is. The second objective is to conceal the avenue of approach and timing of the main attack. Some methods that can be used in an attack are:

- Dummy units and installations.
- Phony radio traffic.
- Movement and suppressive fires in other areas timed to coincide with the real attack.
- Smoke. If a screen is placed across a possible avenue of approach, the defender's attention is drawn to it, while the force attacks from a totally different angle.

Combat Service Support. Offensive operations in this environment may involve considerable expenditure of ammunition and high POL consumption. Units must carry maximum available combat supplies and plans for resupply must be widely disseminated and clearly understood. Every opportunity for resupply is used. The location of captured enemy supplies should be immediately reported to higher headquarters.

ATTACK EXAMPLES

Most offensive operations in desert warfare result in meeting engagements and hasty attacks. Sometimes it is necessary to mount a deliberate attack to penetrate a strong defensive system established around natural or artificial obstacles, in order to get into the enemy's rear. The following examples describe one way in which a meeting engagement might occur, and one way a deliberate attack might be conducted. These scenarios are examples of how particular battles might be fought. Every commander must apply the principles according to his experience and best judgment in each new situation.

MEETING ENGAGEMENT

A meeting engagement occurs when a moving force, incompletely deployed for battle, meets a stationary or moving enemy force, about which it has inadequate intelligence. The action ceases to be a meeting engagement when the situation is developed and subsequent operations are undertaken.

Meeting engagements may occur at all echelons in both offensive and defensive situations; however, they occur most frequently when moving to contact.

The principal characteristics of meeting engagements are a limited knowledge of the enemy and limited time for the commander to develop the situation and to formulate and execute plans.

The key to a meeting engagement is to seize and retain the initiative. By retaining the initiative, a commander can subsequently adopt the best course of action to accomplish his mission.

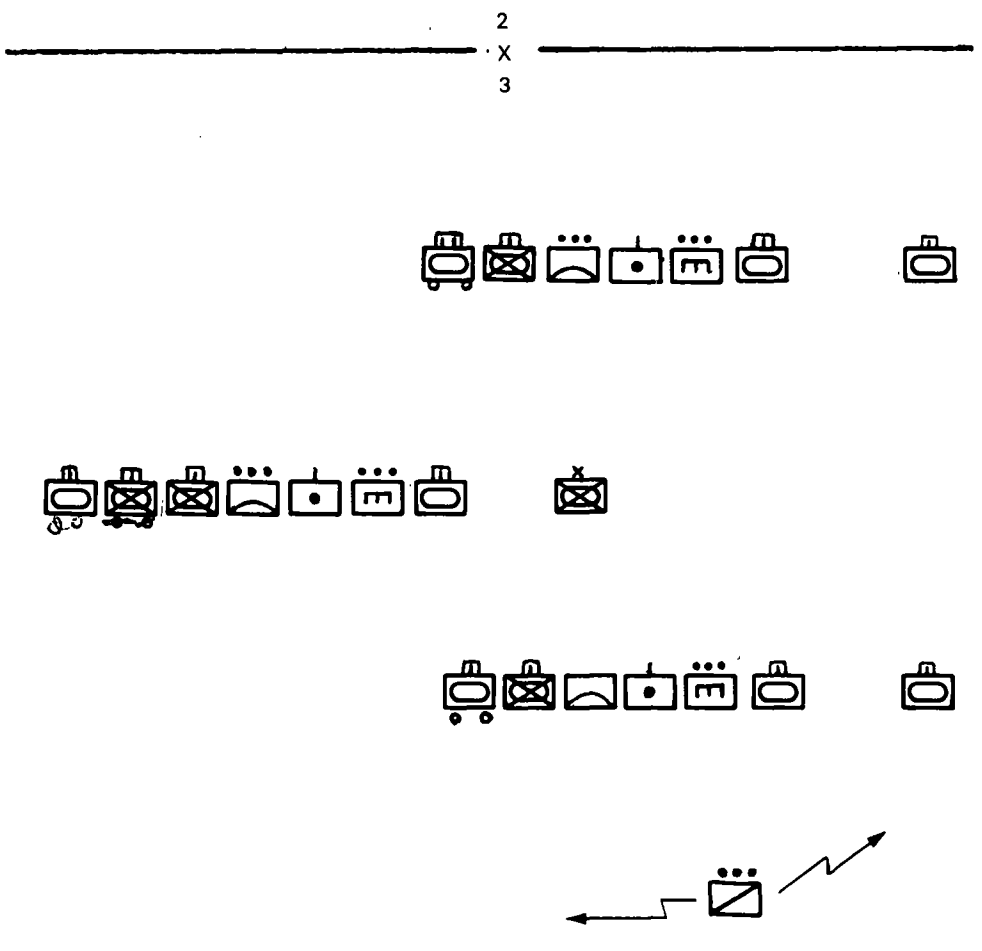
The following actions can assist division, brigade, and battalion commanders in retaining the initiative.

- Make a rapid estimate of the situation and issue fragmentary orders.
- Commit units from march column.
- Organize an advance guard with mobile forces capable of delivering large volumes of direct fire, capable of rapid deployment, and capable of speed in the attack. Use armored cavalry, air cavalry, or tank-heavy teams.
- Intersperse field artillery throughout the formation with some well forward so that indirect fires will be immediately available during any contact.

The enemy situation is developed vigorously and aggressively. Flanking movements generally disclose the enemy's configuration more rapidly than frontal movements and give more opportunity for tactical surprise and decisive results.

The following example illustrates these points. The 52d Infantry Division (Mech) is ordered to move east to contact enemy forces believed to be present, and to occupy a movement objective that includes a series of small oases and water holes about 80 kilometers away. On the division right, 3d Brigade is organized with 2 tank battalions, 1 mechanized infantry battalion, 1 field artillery battalion (155mm, SP), 1 engineer company, and 1 Vulcan battery.

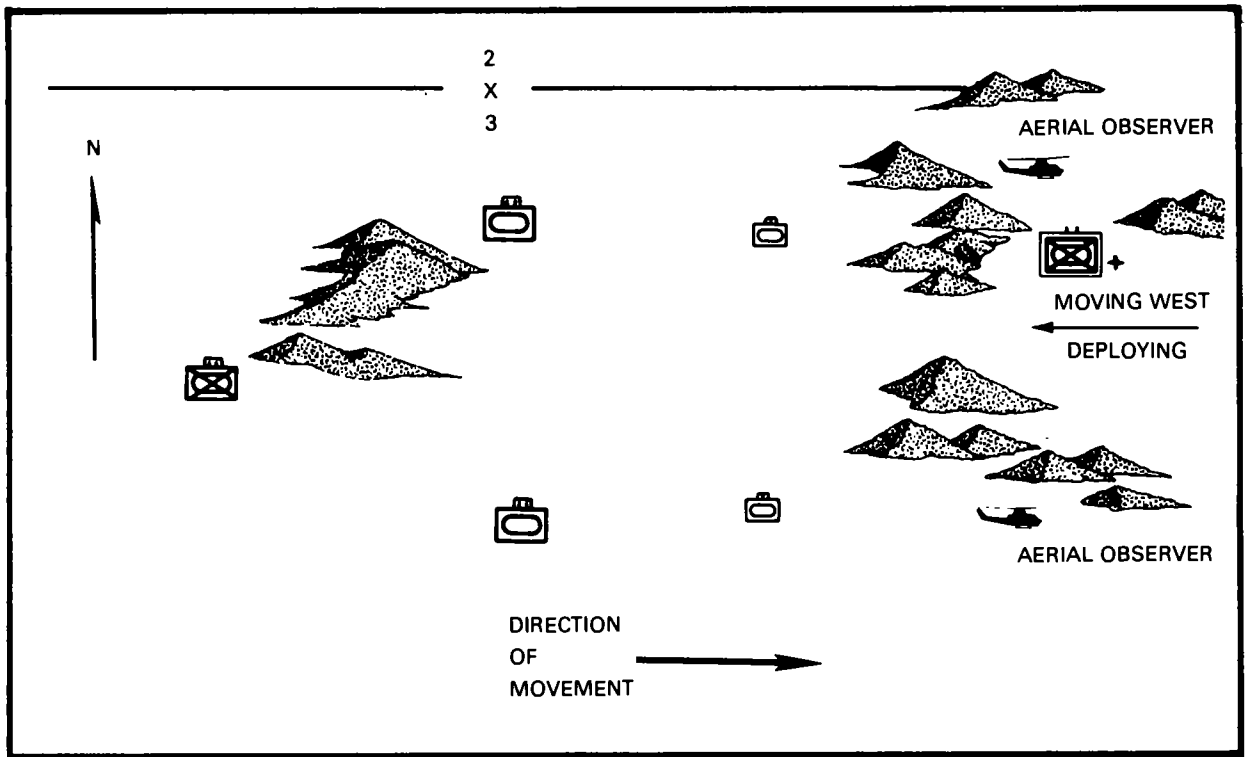
The commander organizes three tank-heavy battalion task forces and deploys for the movement as shown.



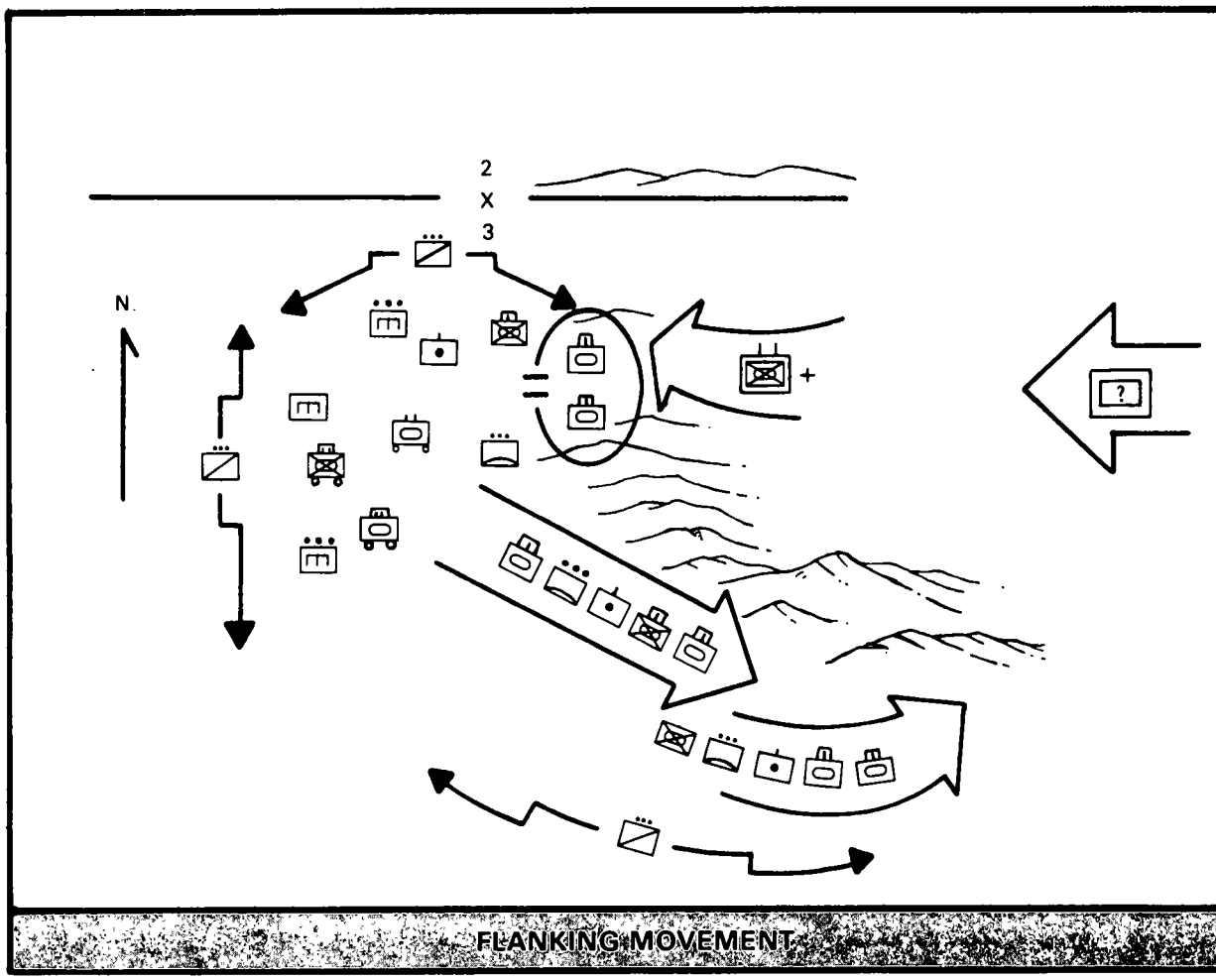
TANK-HEAVY TASK FORCES DEPLOYED FOR MOVEMENT

The brigade has required each leading battalion task force to provide a tank-heavy team as advance guard. They move by traveling overwatch or bounding overwatch as the situation dictates. Right task force is screening the brigade flank with its scout platoon and is prepared to commit 1, 2, or 3 teams if a threat develops on the right. Left task force is maintaining contact (not shown) with 2d Brigade. The brigade commander moves well forward, mounted in a brigade helicopter. Each leading task force commander also has a brigade helicopter. Additional observation helicopters from division artillery are available and are used to supplement the advance guard company teams. Rear task force is responsible for rear guard and has a tank-heavy team marching at the rear with the battalion scout platoon (not shown). Field artillery batteries, Vulcan platoons, and engineer platoons are dispersed throughout the brigade.

The operation commences in the afternoon so that it can be completed by nightfall and so that US forces will have the sun at their backs. Movement is rapid at first, with no sign of enemy activity. After covering about 40 kilometers the aerial observers report several small dust clouds to the front and move off to investigate. The leading tank-heavy teams provide overwatch but continue to move. Shortly thereafter, the helicopter on the left receives a high volume of fire from many automatic weapons. The observer reports an estimated 25 BMPs and 6 or 7 tanks moving west on a collision course with 3d Brigade. This enemy force is assumed to be a reinforced motorized rifle battalion. It is deploying from battalion column to company columns at the time of the report.



MEETING ENGAGEMENT



FLANKING MOVEMENT

The aerial observer completes his initial fire request as the aircraft is forced away by ground fire. An aerial observer for the south reports no enemy activity except the now increasing volume of dust he can see to the north.

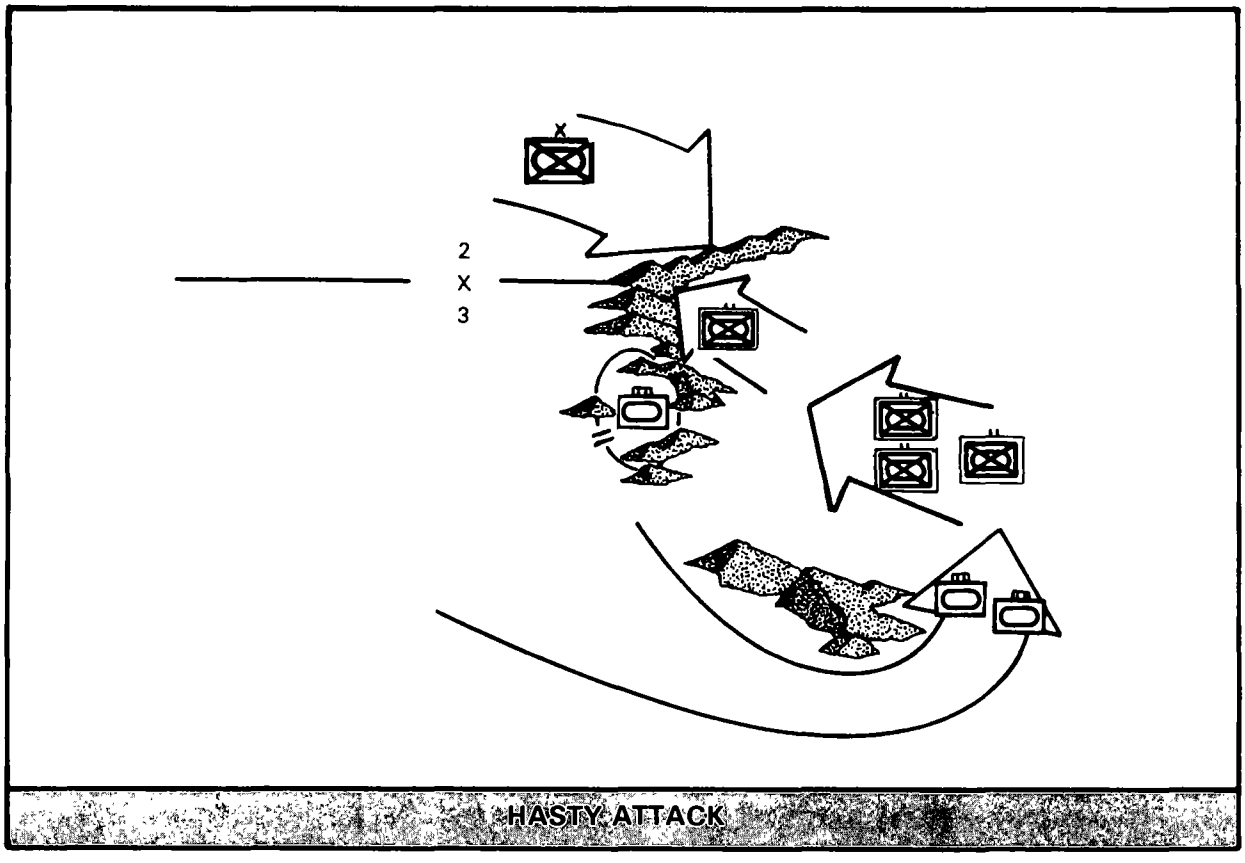
The brigade commander, satisfied that fire is being placed on the enemy and that reports are on the way to division, tells his S3 to be certain 2d Brigade is aware of this contact and then turns his attention to further developing the situation and ordering whatever deployment is necessary.

It becomes apparent, as the leading forces rapidly close with each other, that the enemy is starting to veer slightly to the north, toward 2d Brigade. Behind the leading enemy force another cloud of dust reveals a larger force also moving rapidly west. The brigade commander orders task force left to block and destroy the leading enemy force, and redirects the remainder of the brigade to the southeast to attack the enemy main body from the south and trap it against 2d Brigade. He orders redeployment as shown.

Task force left moves to block the enemy advance and provide a pivot around which the brigade will maneuver. Its rear team moves to the north to prevent enemy maneuver into the 3d Brigade left flank. Its scout platoon screens the left flank and maintains contact with 2d Brigade. The field artillery battery is in position and firing on the enemy battalion. The trains of all three task forces have dispersed within a lightly manned perimeter. On the west the scout platoon of task force rear is screening. The three engineer platoons not needed in support of this maneuver, are providing backup for the scout screen. Task forces right and rear, with field artillery batteries and ADA platoons are maneuvering to strike the enemy main body from the south. The brigade commander intends to make a wide envelopment and thus must take the field artillery batteries with him. The scout platoon of task force right screens the right flank as before.

Having developed the situation, planned the attack, and started to maneuver, the brigade has completed those actions that are part of a meeting engagement. Actions that follow are, in this case, a hasty attack. Conduct of hasty attacks is described in How-to-Fight manuals appropriate to each level of command.

This plan by 3d Brigade was chosen for several reasons. Halting to defend would not satisfy the mission of securing the oasis area still 30-40 kilometers away. Maneuver to the north would drive the enemy to the south and perhaps into the rear or behind 52d Infantry division (Mech). Maneuver to the south drives the enemy to the north and into the path of 2d Brigade where the enemy can be destroyed quickly.



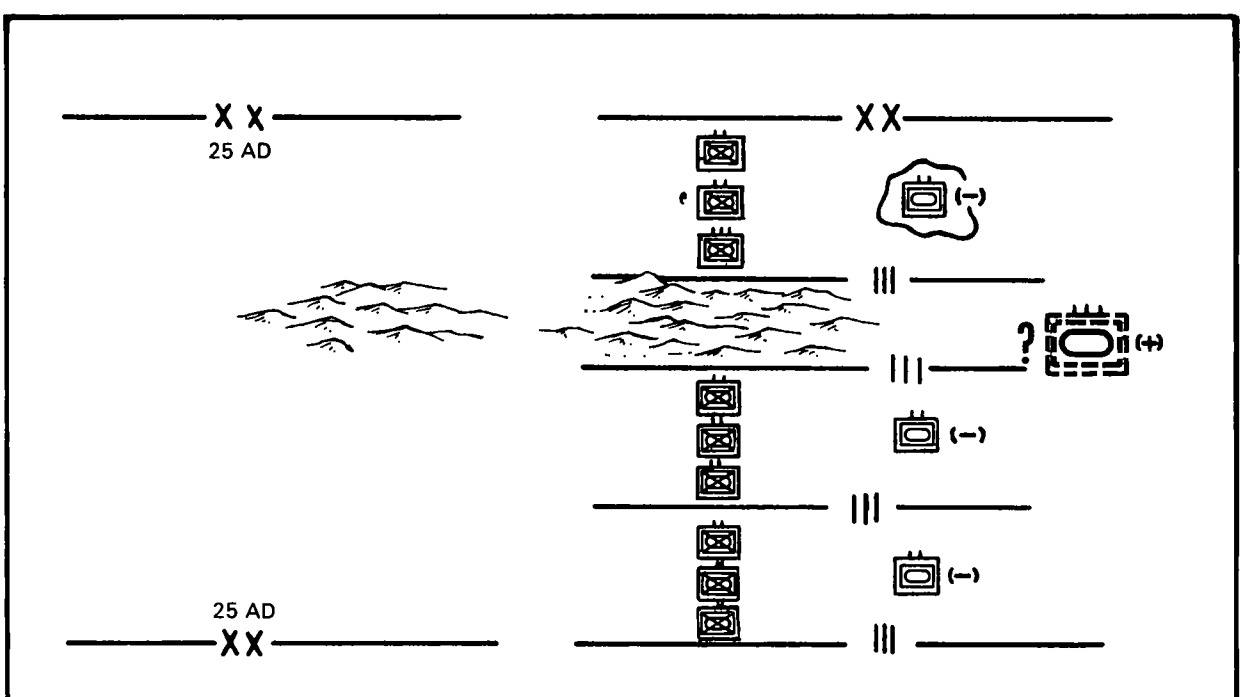
HASTY ATTACK

DELIBERATE ATTACK

The following example describes *one way* in which an attacking division and a brigade might take advantage of the speed and mobility afforded by desert terrain. It must be remembered that as the terrain in the desert becomes more broken, the techniques employed in the attack will more closely resemble those employed in more temperate environments where natural obstacles abound.

General Situation. The 25th Armored Division is making the main attack as part of the corps. The corps has been advancing against scattered resistance for the last 24 hours. Corps G2 has indicated that forward units of the corps will strike the first echelon of the enemy main body the following day. The best intelligence estimate is that the enemy will continue to defend in place.

Special Situation 1. Air and ground reconnaissance has revealed that enemy units occupying defensive positions in the 25th Armored Division zone appear to be three motorized rifle regiments of a motorized rifle division. The tank regiment of the division has not yet been located, but it is believed to be occupying positions in the division second echelon, prepared to counterattack. The G2 estimates that the regiments are defending with all three motorized rifle battalions forward. Motorized rifle battalions have been reinforced with a few tanks each, but the bulk of each motorized rifle regiment's tank battalion appears to be positioned in depth in the regimental second echelon. Two of the regiments are separated by an area of very rocky broken ground, judged impassable to track vehicles. This obstacle is unoccupied, but is heavily mined and covered by observation and indirect fire. Another area of impassable ground, approximately 3 kilometers in diameter, is located 2 kilometers to the front of the enemy's positions. This ground will also present an obstacle that must be bypassed.



MOTORIZED RIFLE DIVISION IN THE DEFENSE

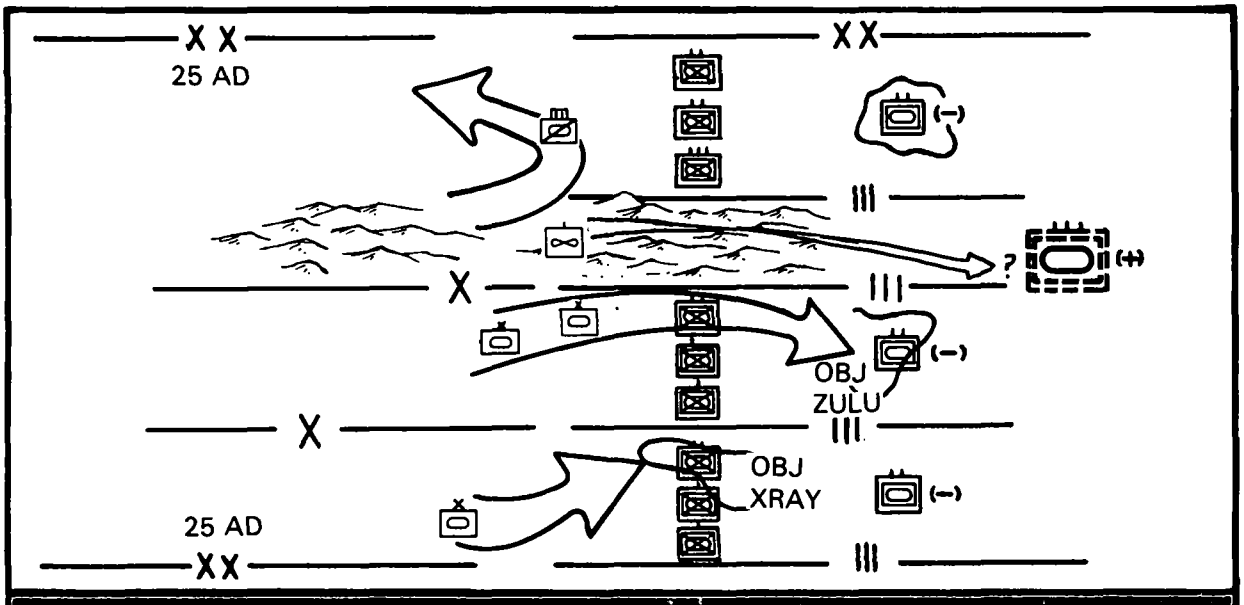
The 25th Armored Division has the mission of penetrating the enemy division first and second echelons. The corps reserve will attack through the penetration to drive into the enemy rear to cut lines of communication and destroy the enemy combat service support system.

The division main attack will be made on a narrow front by a balanced brigade of 2 tank and 2 mechanized infantry battalions, south of the obstacle in late afternoon. The brigade will attack to secure an objective approximately 10 kilometers deep, and will then continue the attack to the east on order. The second brigade, also balanced, will conduct a supporting attack to the south of the main attack to secure an objective in the enemy first echelon. The division reserve, a three-battalion tank-heavy brigade, will follow the main attack, prepared to assist or assume the mission of the leading brigade, and prepared to destroy counterattacks by enemy regimental tank battalions or the enemy divisional tank regiment. The division cavalry squadron will conduct a demonstration to the north of the obstacle as part of the division deception plan. All available indirect fire will be used to seal off the objective areas. A corps attack helicopter company is under operational control of the division to assist in the destruction of enemy counterattacks.

This course of action has the following advantages:

Orienting the main attack on an objective immediately south of the obstacle prevents counterattack and direct-fire engagement by enemy units positioned to its north, and affords the main attack a degree of flank protection. The concentration of a brigade on an estimated enemy company creates a force ratio favorable to success.

A supporting attack and a demonstration will deceive the enemy as to the exact location of the main attack, force him to delay commitment of reserves, and prevent local counterattacks against the main attack by forces in the first echelon.



DIVISION ATTACK

It is impossible to conceal the movement of the main attack. A rapid advance however, will provide the enemy a moving target and obscure all but the leading vehicles with a large dust cloud. Suppressive fires on and around the objective will degrade enemy direct fire from the front and flanks. Attacking from the west will force enemy gunners to look into the afternoon desert sun to engage targets. Finally, operations in the enemy second echelon will be carried out after nightfall, compounding confusion and control problems of enemy counterattacks.

The reserve is located to further concentrate combat power against the enemy's weakest point. After the lst Brigade penetrates the enemy's first echelon, the reserve can either pass through to attack the second echelon or react in any direction to destroy enemy counterattacks.

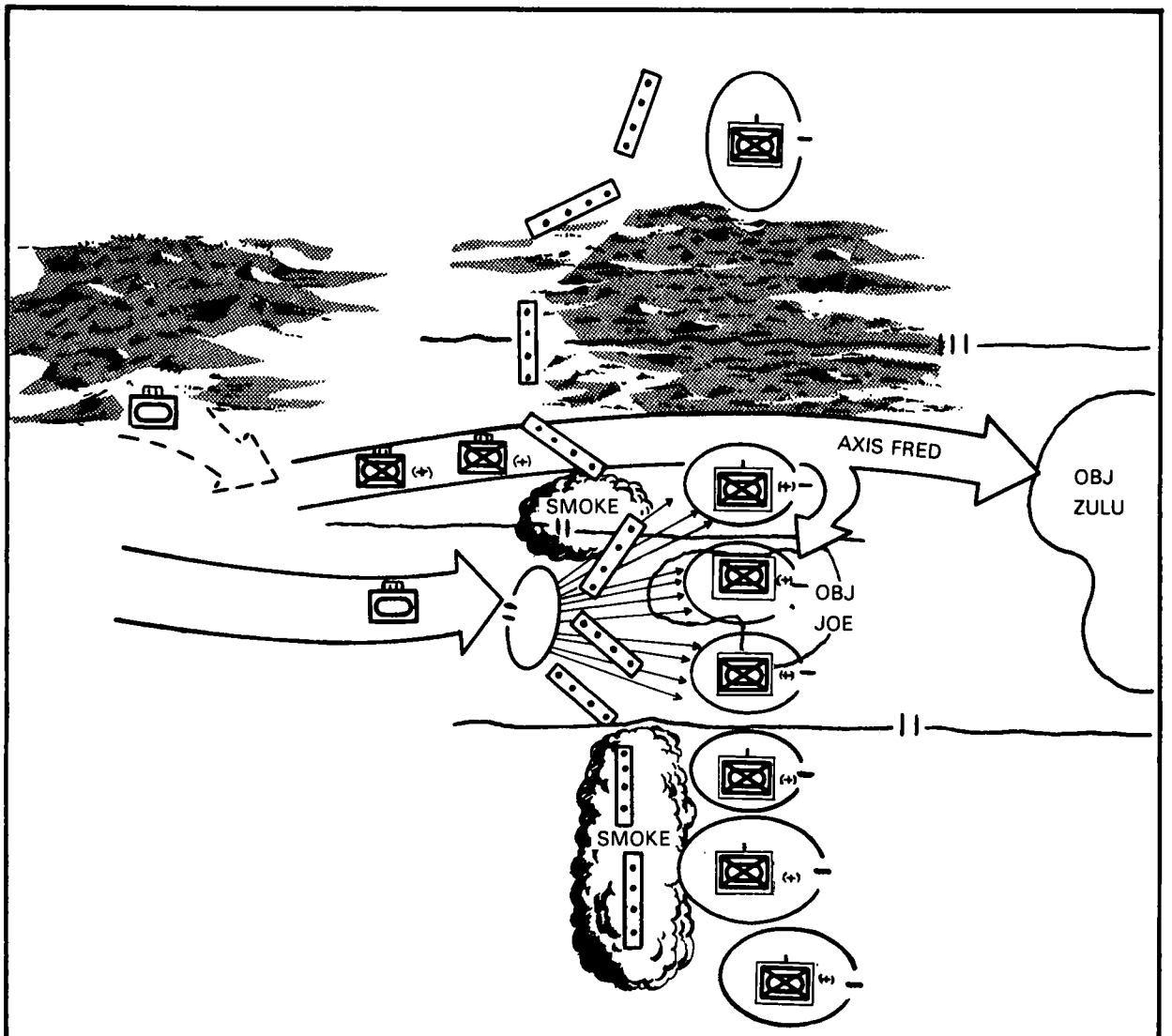
Continuing the attack east into the enemy rear with the main attack or the reserve brigade will retain the initiative, maintain the momentum of the attack, and orient on the enemy's greatest vulnerability—his combat service support system.

Special Situation 2. The brigade conducting the main attack is organized with 2 mechanized infantry battalions and 2 tank battalions.

It has 1 field artillery battalion in direct support and reinforcing fires from 2 additional battalions. Two engineer companies are also in direct support. Based on his analysis of terrain, the brigade commander realizes that his units will be unable to conceal their approach from the enemy. He therefore plans to approach the enemy positions as rapidly as possible from an area far enough away as to be initially obscured from visual observation by the rolling terrain and heat haze. The dust cloud created by the brigade will inform the enemy that a large force is approaching, but it will also prevent the enemy from determining the size and composition of the force. During the approach, enemy positions will be suppressed with smoke, and battalion task force scout platoons will move ahead of the main body to identify obstacles.

The main attack will be led by a mech-heavy battalion task force with the mission of punching through the enemy first echelon just south of the obstacle. The following task force, also mech-heavy will follow in and attack the enemy first echelon unit on *objective* JOE from the rear. These two mech task forces will be followed by a tank-heavy task force—initially the brigade reserve. An engineer company will accompany each attacking mech-heavy task force. Meanwhile, a tank battalion task force will advance on the right (south) and abreast of the leading mech task force. It will take up firing positions and suppress enemy first echelon positions immediately to the south of the area of penetration. When *objective* JOE is assaulted from the rear by the second mech task force, this tank battalion will follow the tank-heavy task force of the brigade along *axis* FRED and become part of the brigade reserve. These two tank-heavy task forces will rapidly press forward on *axis* FRED and seize *objective* ZULU.

The major threat to the success of the plan is a counterattack by the regimental tank battalion or the divisional tank regiment. These enemy forces may be tied down by the division supporting attack and demonstration. However, the brigade commander makes plans to defeat a counterattack from any direction in the event that the enemy determines the location of the main attack and commits his tank units before the brigade has reached its objective. Initially, the



DIVISION MAIN ATTACK

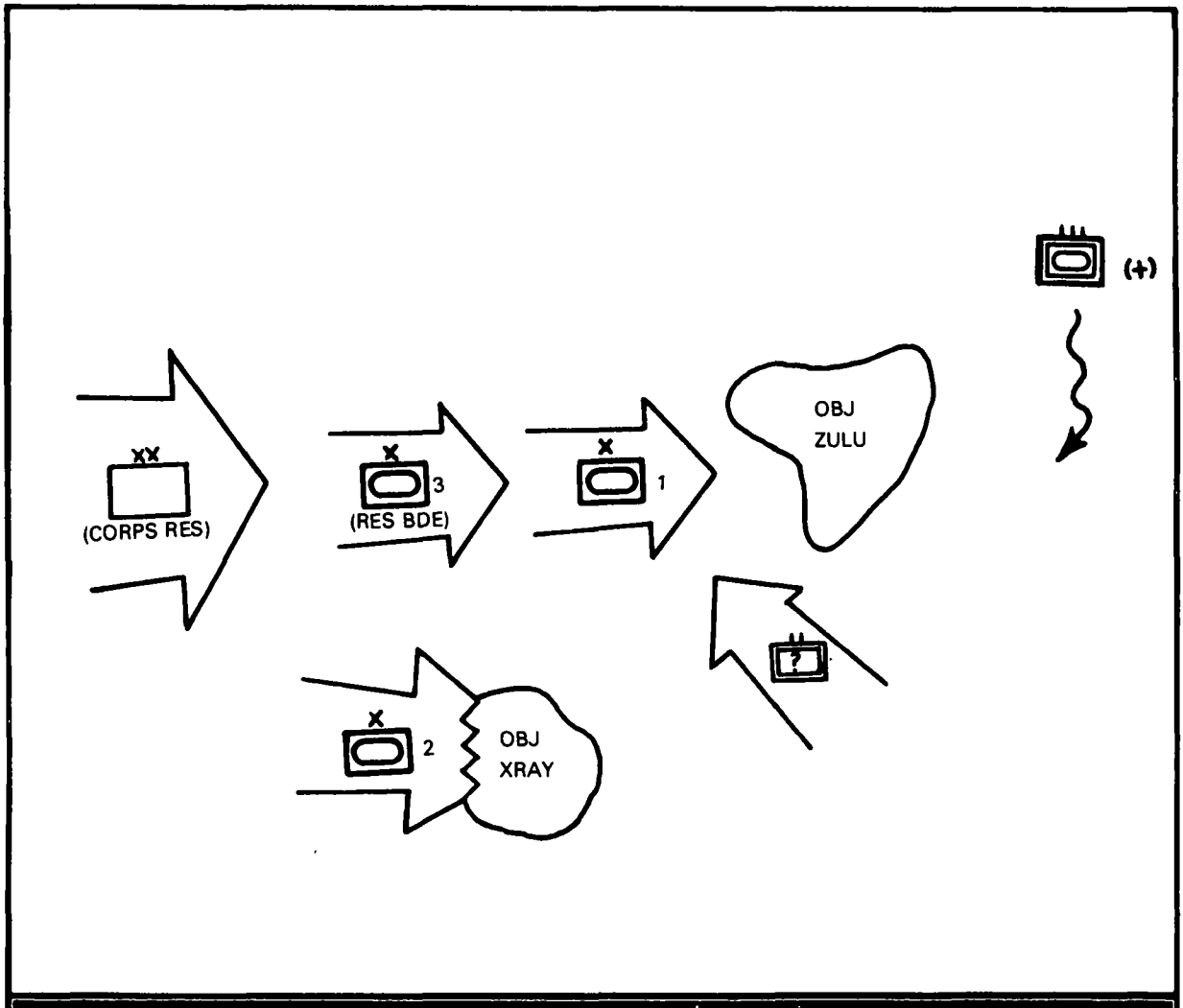
northern flank of the brigade will be protected by the obstacle. The brigade main attack will be exposed to an enemy counterattack from the south, but unless the counterattack takes place before the brigade supporting attack has reached its objective or the main attack has punched through, it will be destroyed by the fires of both battalion task forces. With his entire regimental sector under attack, it is unlikely that the enemy regimental commander will be able to determine the time and place to commit his tank battalion until it is too late. Once the brigade reserve is through the first echelon, a counterattacking enemy tank battalion will be faced with an extremely unfavorable force ratio.

The enemy tank regiment also poses a dangerous threat. A counterattack by a force that size early in the attack will have a good chance of blocking the penetration. Fortunately, the enemy division commander is faced with a problem similar to his regimental commander's. With the entire division under attack, it will be extremely difficult for him to determine the correct time and place for the counterattack. The attack helicopter company committed through the gap in the enemy defenses can intercept the enemy tank regiment, attack it by fire, and cause it to delay its counterattack against the penetration. Once the brigade secures its objective, the tank regiment will be forced to attack a defending force of equal size with the advantages accruing to the defender. Once the division reserve brigade has moved up behind the leading brigade, a counterattacking enemy regiment will itself be exposed to counterattack.

The brigade plan of attack has the following advantages:

- The main and supporting attacks are planned on narrow fronts to increase the chances of favorable force ratios for the attacker. The main attack will take advantage of an enemy weakness by attacking through an area occupied by minimum enemy forces and with one flank protected by an obstacle.
- The proximity of the main and supporting attacks allow mutual support.
- The reserves will be readily available for commitment and their fires are used to support the main effort.
- A rapid, violent advance out of the sun will make target acquisition and engagement difficult for enemy gunners who are not suppressed.
- The plan takes full advantage of the mobility and speed of track vehicles.
- The scheme of maneuver keys on the mobility and speed afforded by the terrain, and allows enemy commanders very little information or time to react.
- The plan fully supports the division scheme of maneuver, which is to rapidly advance into the enemy's rear to destroy his combat service support.

Special Situation 3. The reserve brigade is organized, as before, with 2 tank battalions and 1 mechanized infantry battalion. Because the division mission is to penetrate the two defensive echelons of the enemy division, this brigade has been organized with sufficient tank strength to assist the lst Brigade (main attack), assume its mission, or defeat enemy counterattacks. When this brigade is committed it will become the main attack of the division. It will have a battalion of field artillery in direct support, and as much additional field artillery support as can be devoted to this action at the time. The brigade has a combat engineer company and an air defense artillery battery, which make it a strong and self-contained combined arms force capable of semi-independent action, necessary if this brigade is to achieve decisive results in this attack.



ENEMY COUNTERATTACK

The attack by 25th Armored Division was launched on schedule and progressed generally according to plan. The enemy commander, apparently unable to determine where the main thrust was being made, withheld his counterattacks. 1st Brigade (main attack) succeeded in penetrating the enemy first echelon and continued, with little loss in momentum, toward *objective* ZULU. As the leading battalion task forces approached ZULU they reported a counterattacking enemy tank force approaching from the southeast.

1st Brigade committed its following battalion task forces to continue into *objective* ZULU while the leading task forces met this enemy counterattack. At approximately the same time the division G2 received information from the commander of the attack helicopter company that the enemy tank regiment, had been attacked and was identified moving south. When the corps commander evaluated the situation, including the progress of 25th Armored Division, the movement of the tank regiment, and original corps plan, he issued a fragmentary order.

He instructed 25th Armored Division to continue toward ZULU and to defeat the enemy tank regiment on ground that would leave the way clear for the corps reserve division to pass north of ZULU and into the enemy rear.

Based upon this, Commander, 25th Armored Division, identified three options. He could:

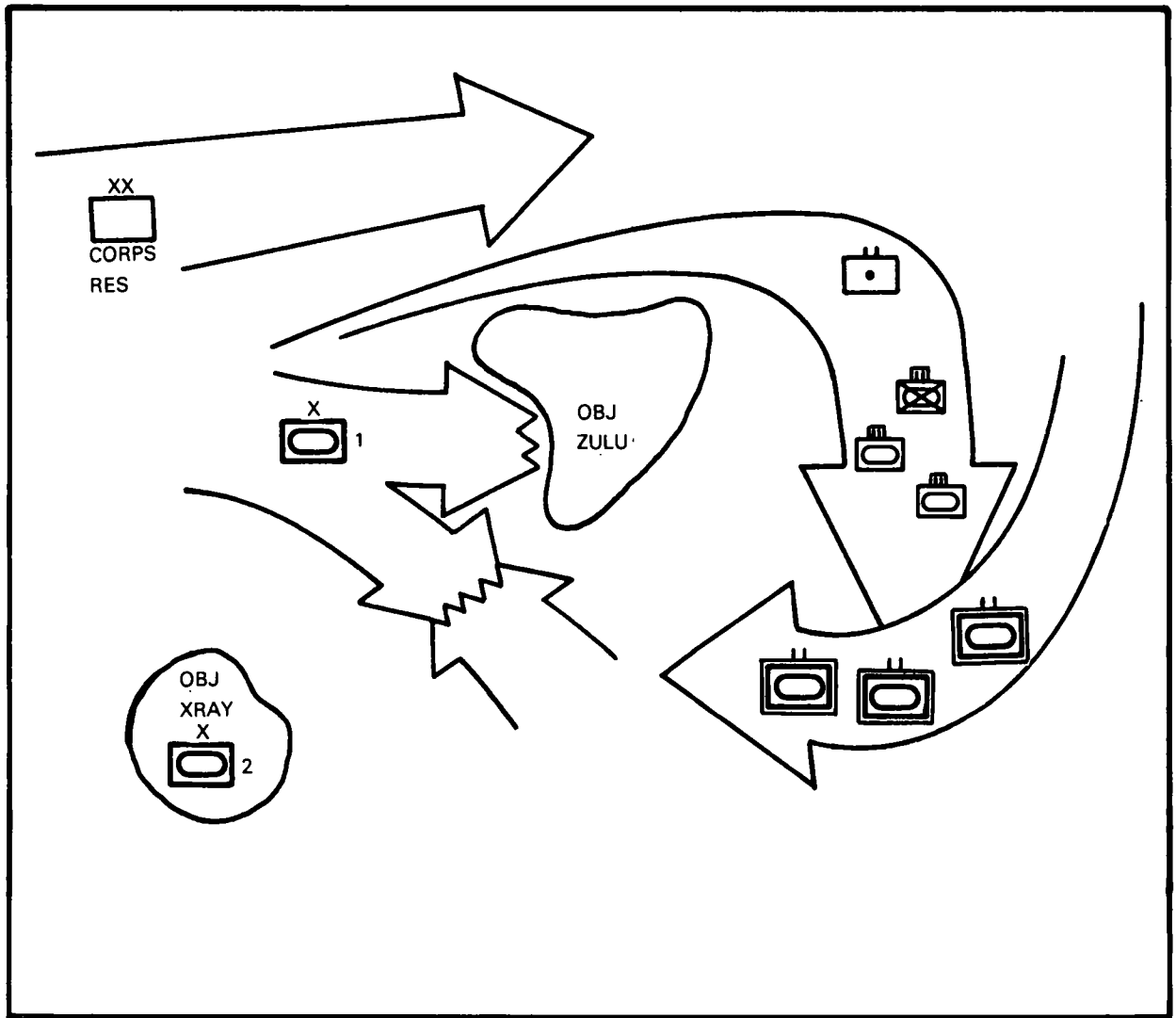
(1) Commit his reserve brigade to the southeast to meet and block the enemy regiment somewhere south or southeast of ZULU. This had the advantage of keeping 25th Armored Division forces massed to some degree. It had the disadvantages of requiring maneuver of the reserve brigade through or around the ongoing battle between 1st Brigade forces and the smaller enemy counterattack, and of meeting the enemy regiment nose on.

(2) Commit his reserve through *objective* ZULU to strike at the flank of the enemy regiment. This angle of attack would be advantageous, but the requirement to pass through 1st Brigade and ZULU would slow the commitment of the reserve.

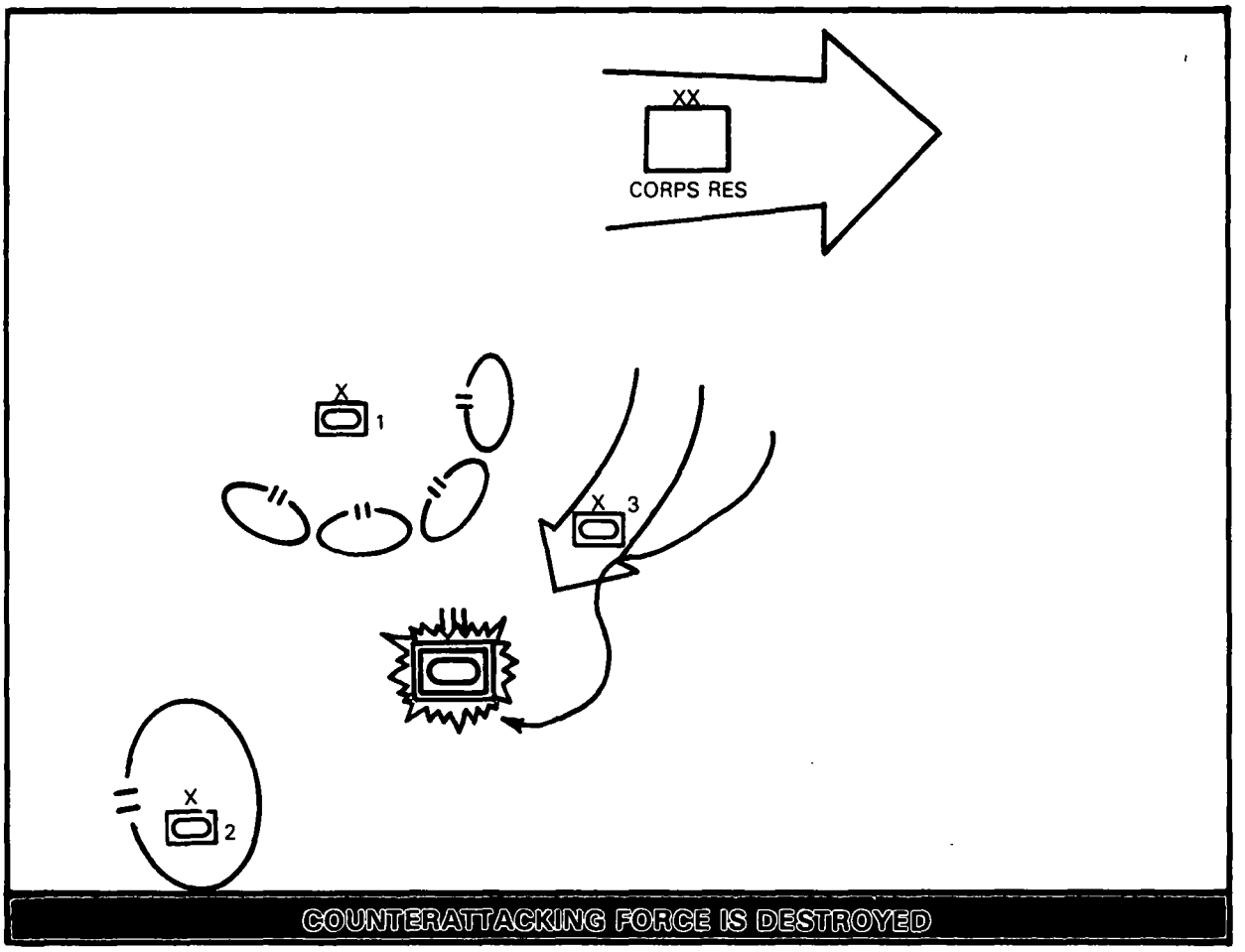
(3) Commit his reserve around the north side of *objective* ZULU to strike the enemy tank regiment in its flank and rear. This would be slower in terms of overall distance to be traveled, but require no passing of one force through another. It also would permit pinning the enemy against 1st and 2d Brigades, and most importantly, tended to ensure that the major enemy forces in the area would be out of the way of the corps reserve as it passed to the north of ZULU.

The 25th Armored Division commander chose option (3) and committed his reserve brigade at once. Once committed, the brigade received direct support of one field artillery battalion. Due to the distance over which this wide envelopment was to take place, this field artillery battalion accompanied the brigade until it reached an area from which it could provide fire for the attack. Air defense weapons and engineers also moved out with the brigade.

As 3d Brigade attacked into the flank of the enemy regiment, the leading brigade of the corps reserve division drew abreast of *objective* ZULU and continued on to the east into the rear area of the enemy division.



RESERVE ATTACKS FLANK OF COUNTERATTACK FORCE

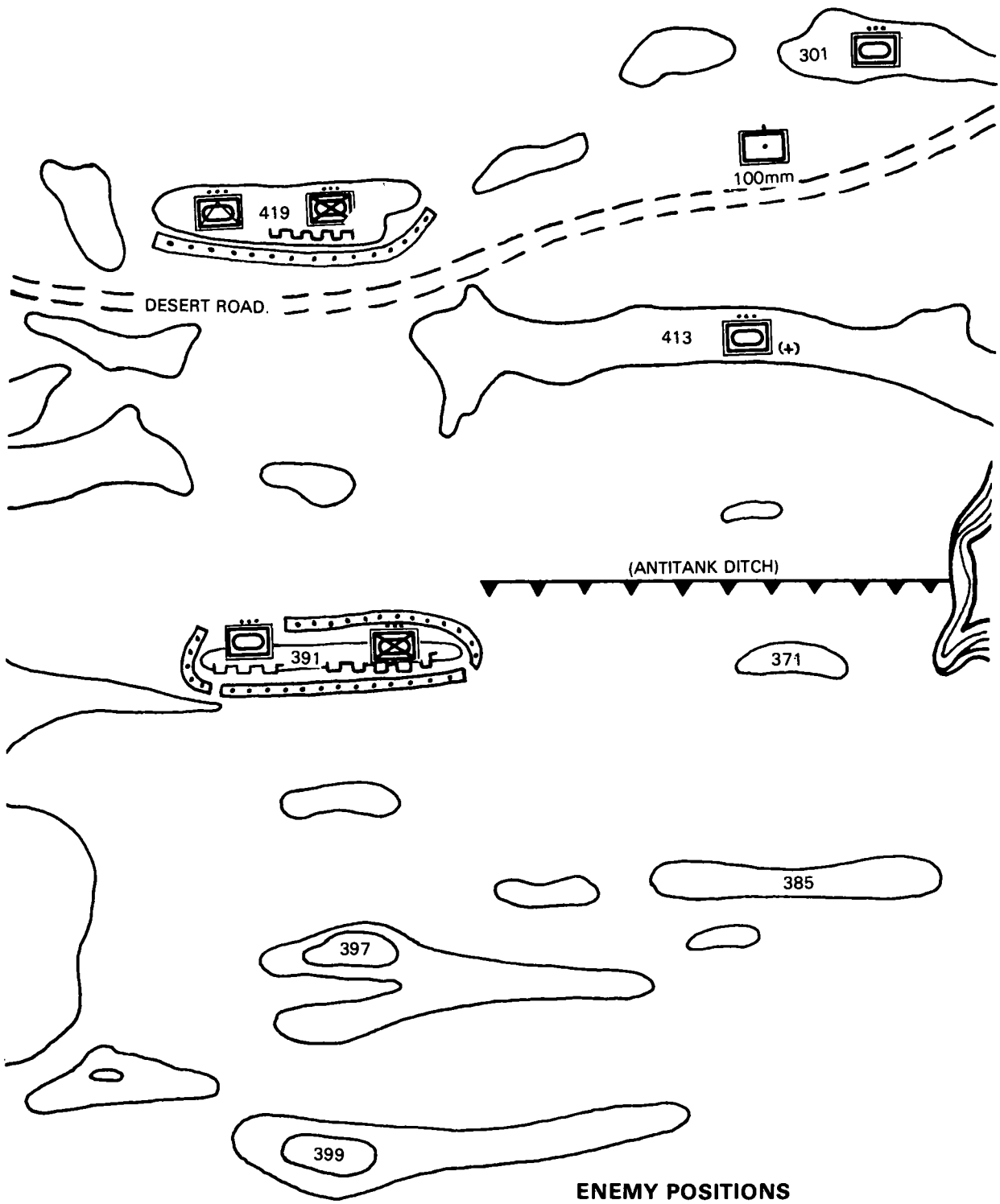


The enemy tank regiment was trapped among the three US brigades and destroyed. The 25th Armored Division then consolidated, reorganized, and prepared to continue to the east to follow and support the corps main attack.

In this situation the 25th Armored Division succeeded in rupturing the defenses of an enemy division, cleared the way for the corps reserve to exploit the breakthrough, and met all counterattacks. It applied offensive fundamentals to desert environment and defeated an enemy division.

Special Situation 4. The following example describes one way in which a tank company team might conduct an advance guard mission during a movement to contact. In this situation the 25th Armored Division is moving rapidly through the enemy security zone in order to rapidly close on the main enemy defense positions. Company A is the advance guard for the task force and has 3 tank platoons and 1 attached mechanized infantry platoon. A squad of combat engineers is with the mechanized infantry platoon to assist in breaching minefields. The battalion's AVLB section is in direct support and available to the company commander on call. An artillery battery of 155mm SP howitzers is dedicated to Company A.

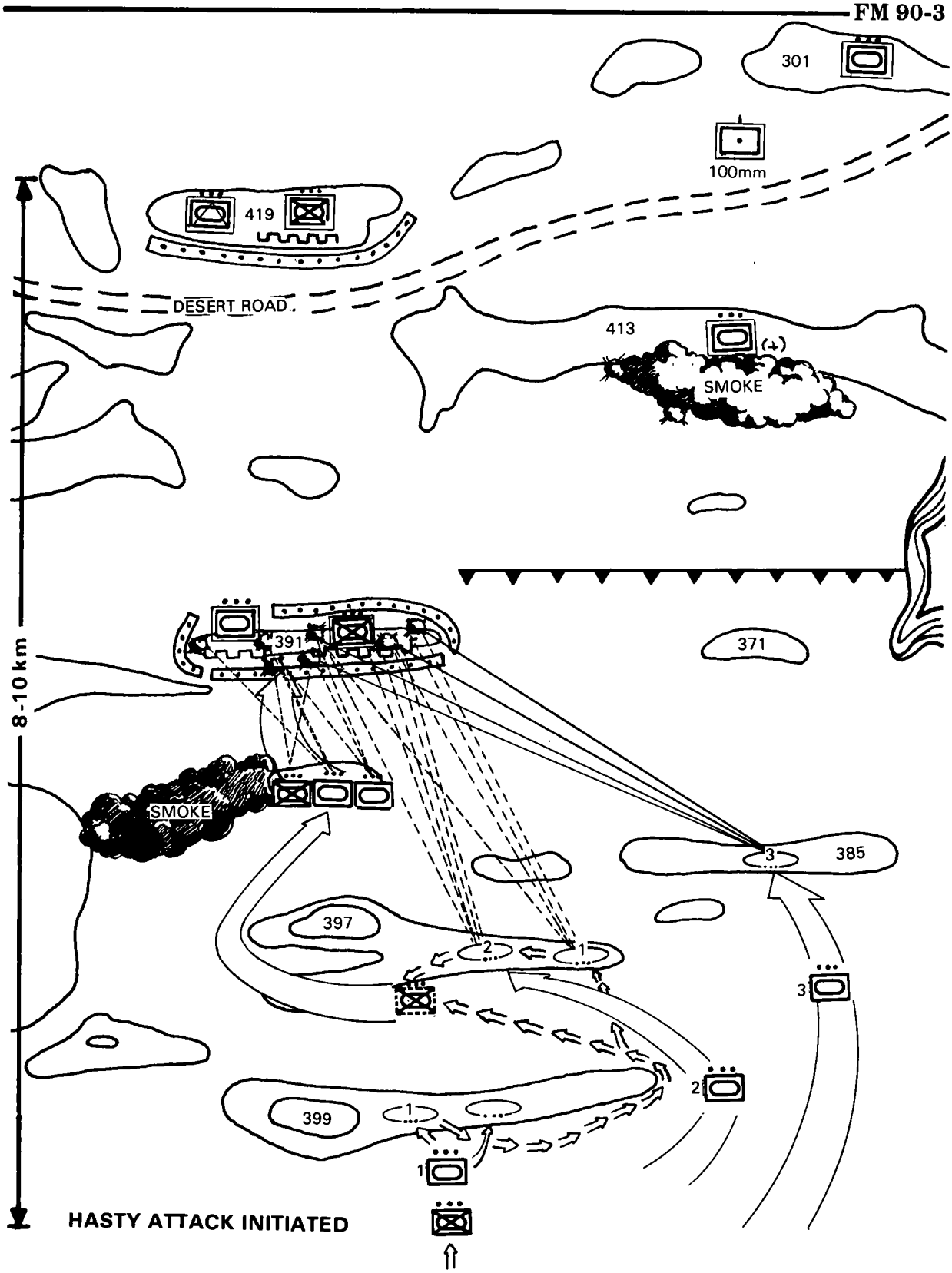
The enemy and terrain are as depicted in the following sketch. The desert terrain is broken with numerous hills and ridge lines rising to an average height of 20-30 feet above the desert floor. Most of these terrain features can be scaled by armored vehicles. The enemy has a dug-in infantry platoon and tank platoon on Hill 391. It is surrounded by a protective minefield. North of Hill 371 an antitank ditch has been dug, anchored on the east by a steep escarpment that is untrafficable to armored vehicles. Enemy tank platoons are located on Hills 413 and 301. On Hill 419 an enemy infantry platoon is dug-in and supported by an antitank platoon of BRDM vehicles with Sagger missiles. It is partially protected to the south and east by a protective minefield. An enemy artillery battery of six 100mm howitzers is located along the desert road between Hills 413 and 301.



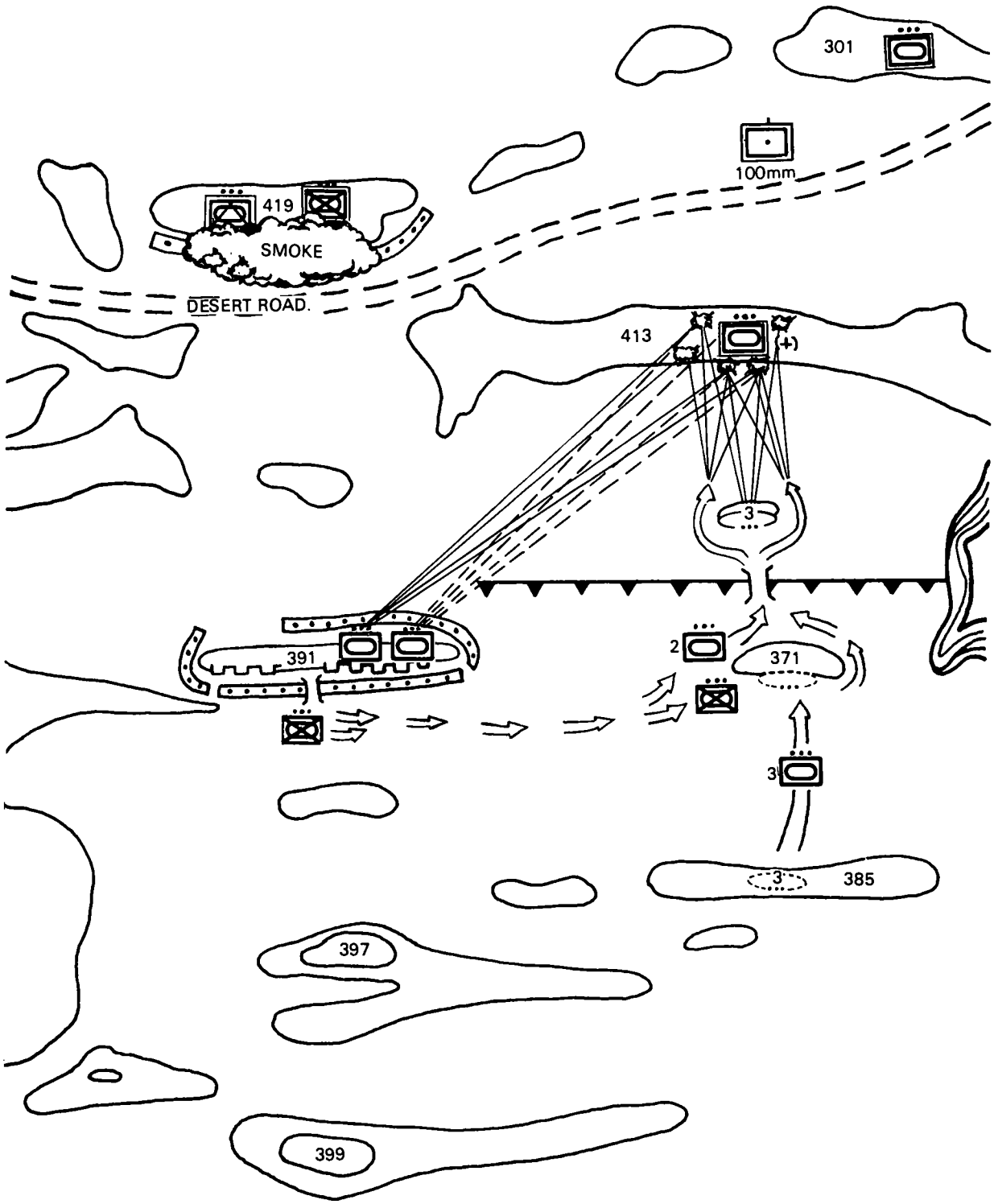
ENEMY POSITIONS

Company A advances to the north by employing the bounding overwatch technique with its platoons (in the following sketch). The lead tank platoon, the 1st Platoon, occupies Hill 399. The mech infantry platoon follows and also occupies Hill 399. They observe to the front and determine that Hills 397 and 385 do not appear to be occupied by the enemy. Enemy positions are observed on Hill 391, but since they are out of effective range no fire is exchanged. The company commander passes the 2d Tank Platoon around Hill 399 and occupies Hill 397. Enemy tanks on Hill 391 open fire against the 2d Platoon on Hill 397. The 2d Platoon returns the enemy fire. Desiring to build up his firepower as rapidly as possible, the company commander moves the 1st Platoon from Hill 399 to Hill 397 to join the 2d Platoon and bring its fires against the enemy on Hill 391. The mech platoon follows but remains in complete defilade behind Hill 397. The company commander decides to move his 3d Tank Platoon to Hill 385 in order to get better flanking shots into the enemy tank platoon positions. The 1st and 2d Platoons cover by fire the movement of the 3d Platoon. With platoons in good firing positions on Hills 397 and 385 a tank duel ensues with the enemy on Hill 391. Artillery fires are placed on the dug-in enemy infantry platoon in order to suppress any suitcase Saggers that may be present on that position. Smoke is employed against the tank platoon on Hill 413 to ensure that it cannot bring effective fires against friendly elements. Due to superior tank gunnery, the overwhelming volume of fire, and the excellent angles of attack, the friendly tanks gain the edge in the duel and knock out several enemy tanks. The company commander senses the moment is right to take Hill 391.

Keeping the 3d Platoon on Hill 385 to overwatch the movement of his other platoons, the company commander begins his maneuver. His forward observer calls upon the battalion 4.2-inch mortar platoon to lay down a small smoke screen northwest of Hill 397 to shield his movement forward to a small hill. This small hill north of Hill 397 is the last cover available prior to assaulting the enemy on Hill 391. From this closer range, the two tank platoons deliver more effective fire against the remaining tanks of the enemy tank platoon. Now the combined suppressive fires of the dedicated artillery battery and the battalion 4.2-inch mortar platoon are directed against Hill 391. Both smoke and HE are employed. As soon as this suppressive fire becomes effective the maneuvering tanks and APCs move rapidly to the minefield. Under cover of the tank and artillery fire, the combat engineers swiftly breach a lane through the minefield and tanks and mech infantry pour through as fast as possible. The mechanized infantry rapidly dismount their carriers and get into the enemy trenches to root out the last remaining enemy resistance. Company A rapidly consolidates and reorganizes on Hill 391.


301
100mm
419
DESERT ROAD
413
(+)
SMOKE
391
371
8-10 km
SMOKE
385
397
399
HASTY ATTACK INITIATED

The company commander acts decisively to keep up the momentum of the advance. The 1st and 2d Platoons immediately engage the enemy tank platoon on Hill 413. The company commander shifts the smoke to Hill 419 in order to obscure the vision of the enemy Sagger gunners located on that position. Under the covering fire of the two tank platoons on Hill 391, the 3d Platoon advances to the north to Hill 371. The AVLB is called forward and under the covering fires of all three tank platoons spans the antitank ditch. The 3d Platoon rapidly crosses the antitank ditch on the AVLB and takes up firing positions on a little knoll just to the north of the ditch. Under the covering fires of the 3d Platoon on the knoll and the 1st Platoon on Hill 391, the 2d Platoon and the mech platoon move across the antitank ditch and join the 3d Platoon. The combined fires of all 3 tank platoons take a heavy toll, knocking out 3 tanks of the enemy platoon. The surviving tank withdraws to the north. Observing this withdrawal, the company commander rapidly advances the 2d and 3d Tank Platoons.



CONTINUING THE ATTACK

This rapid advancement to Hill 413 catches the enemy artillery battery in the open as they were in the process of withdrawing from their position. The two tank platoons completely destroy the surprised enemy artillery battery. The mech platoon closes on Hill 413, but remains in complete defilade. From his positions on Hill 413 and Hill 391 the Company A commander now directs his fires against the enemy on Hill 419. The enemy tank platoon on Hill 301 is smoked in order to reduce its effectiveness. Artillery, mortar, and tank fires are brought to bear against Hill 419 in order to suppress the Sagger missiles on that position. Under cover of this suppressive fire the 2 tank and 1 mech platoons on Hill 413 begin to maneuver to assault the enemy on Hill 419. The 3d Tank Platoon moves to a good firing position on the western edge of Hill 413 in order to bring effective fires to bear at a relatively short range. Under cover of the fires of the 1st and 3d Platoons, the 2d Platoon and the mech infantry platoon breach the minefield and assault the enemy positions. As soon as they are into the enemy positions on Hill 419 the 3d Platoon moves up rapidly to join them in mopping up the last remaining enemy resistance.

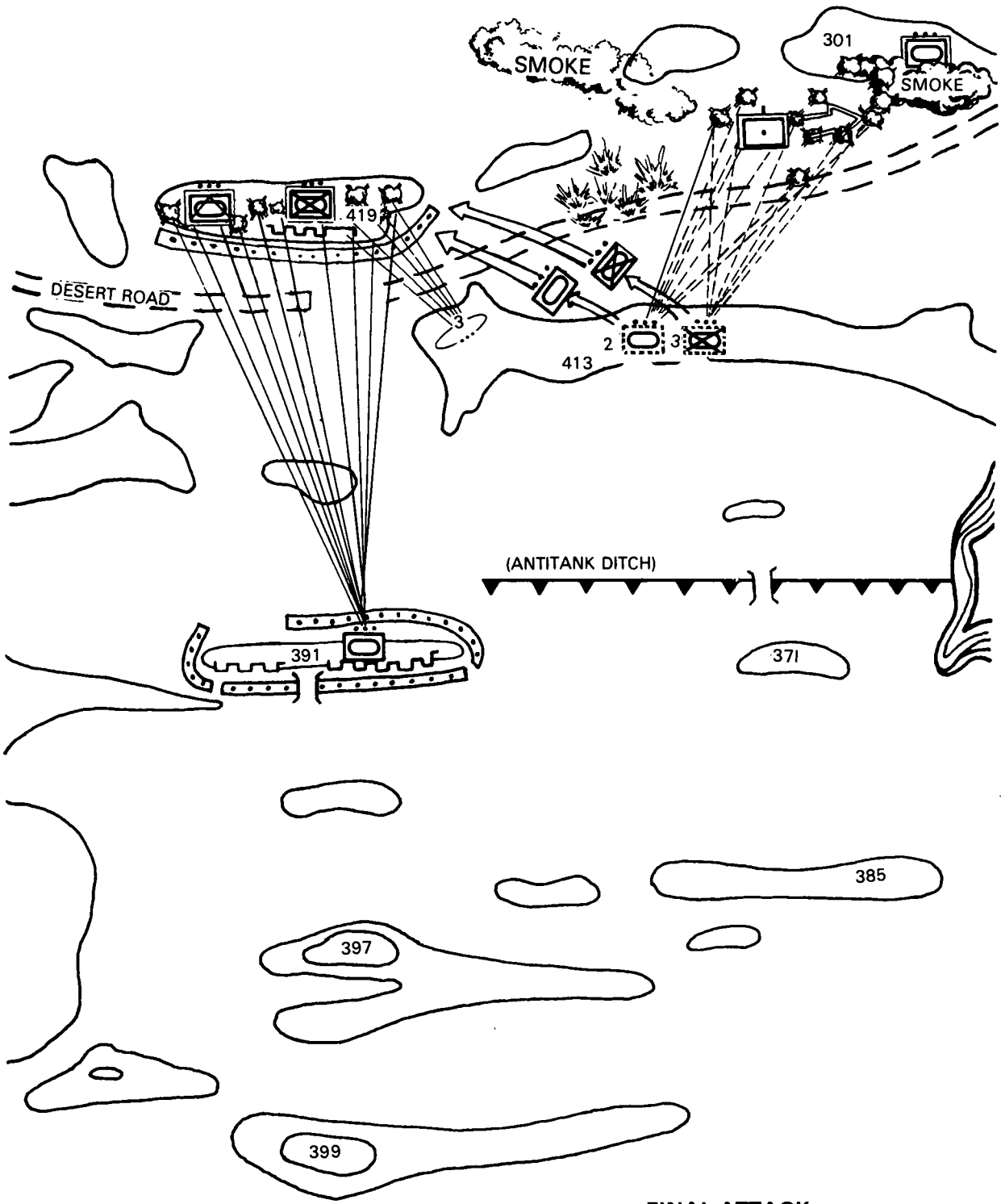
This example highlights the following techniques:

One element is always in position to cover by fire while another element is moving to a new position.

The combined arms team of tanks, infantry, and artillery, is effectively employed to maximize the capabilities and minimize the limitations of each. No single arm can do it alone.

The maximum use of terrain is made to protect friendly elements from enemy fire while moving and to provide good firing positions.

A rapid and aggressive tempo is maintained which keeps up the momentum of the attack.

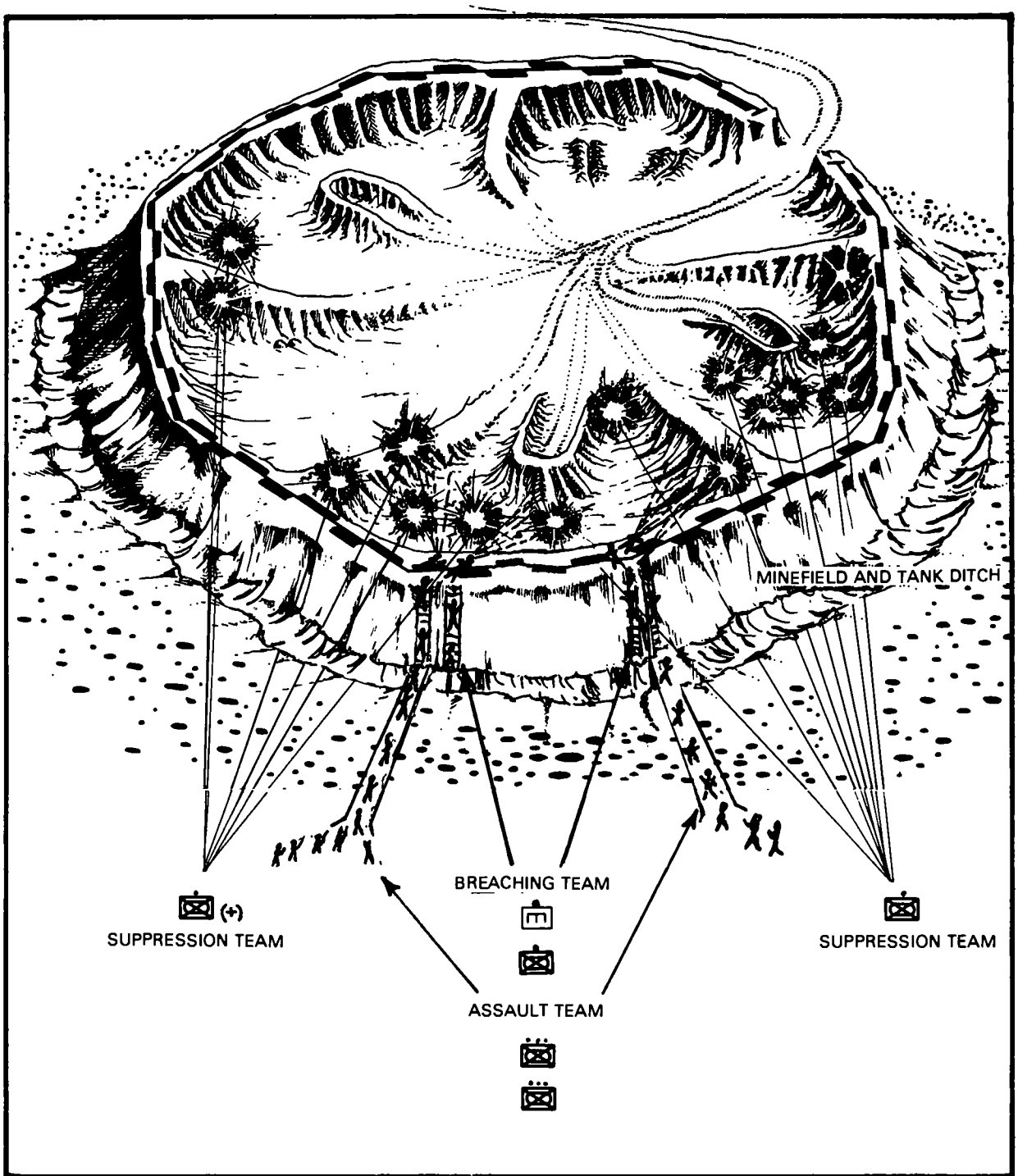


FINAL ATTACK

Special Situation 5. Because of the possibility of encountering strongpoints during desert operations, the following example suggests one way to attack a strongpoint. Normally, strongpoints should be bypassed or neutralized by air or artillery whenever possible; however, there may be times when there is no other recourse but to assault and capture a strongpoint. In such a circumstance the attack of a strongpoint is normally conducted by dismounted infantry at night or possibly during a blinding sandstorm to achieve surprise and minimize casualties. One technique for reducing a specific type strongpoint is presented in the following example. This attack is described in three phases; however, during the conduct of the operation these phases flow together rapidly.

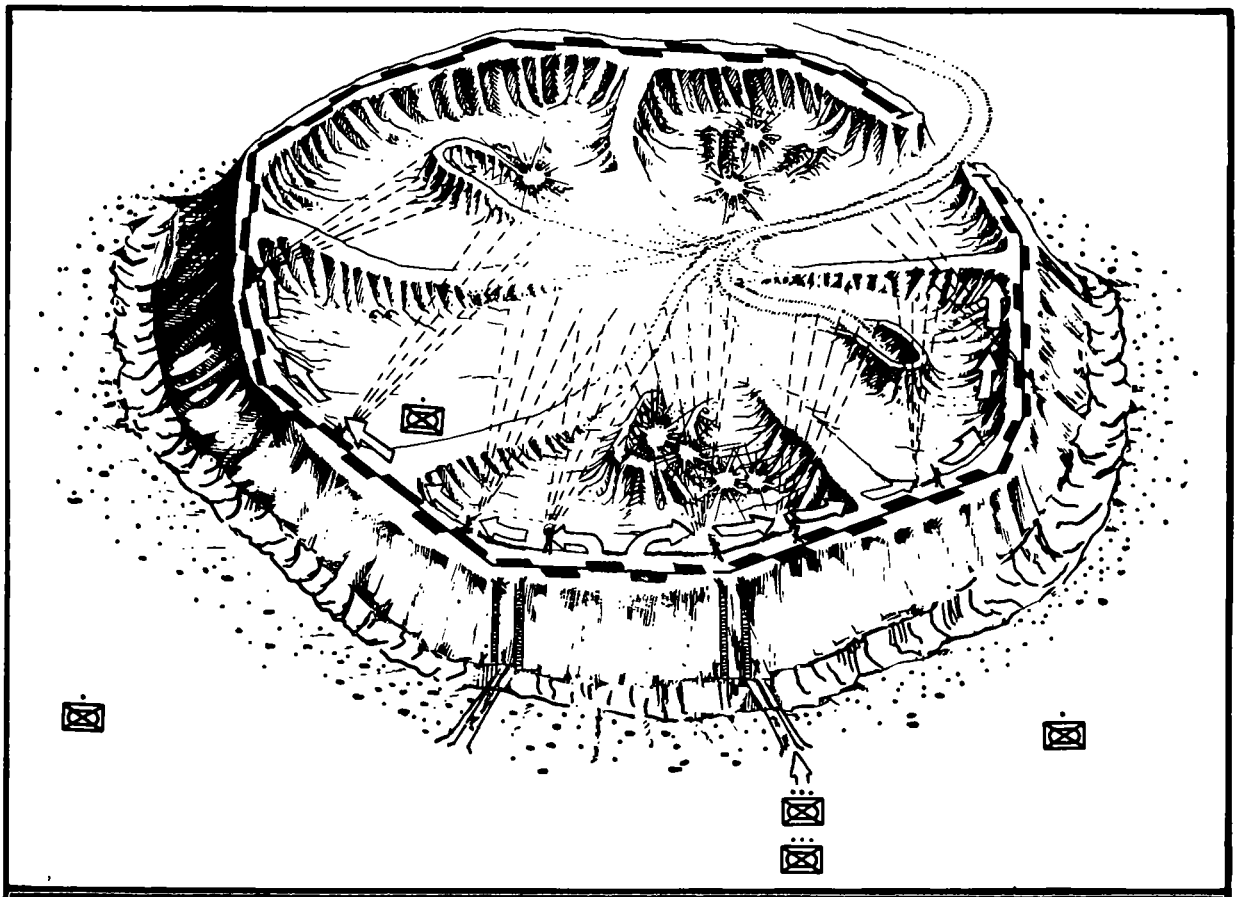
Phase I (Breaching). The first phase consists of breaching the minefield. Preferably, combat engineers are used for this task; however, all infantrymen must be trained and prepared to accomplish this. Because of the construction of this type of strongpoint, it is usually not practicable to assault with armored vehicles. Therefore, dismounted infantry must be used. The breaching group may be composed of three separate elements—a breaching team and two suppression teams. The breaching teams may be composed of an engineer squad to breach the minefield and an infantry squad to assist and to help the assaulting forces to get through the lane, the antitank ditch, and over the berm.

The initial phase of the attack is characterized by stealth. No one opens fire until the attack is discovered. Once the attack has been discovered, the suppression teams concentrate a high volume of automatic weapons and antitank fires near the intended breaching points. Other tanks and APCs are also used farther to the rear in an overwatching role and their fires may be intensified once the attack has been discovered. Similiarly, when the attack is discovered the entire strongpoint is suppressed with artillery and mortar fires (HE and smoke). Once the breaches of the minefield have been made, the breaching teams assist the passage of the assaulting forces by marking the lanes, setting up small ladders, and by assisting the assaulting troops to go where they are supposed to. One technique to do this is to use small colored lights to designate which troops go to the right and which go to the left. For example, a small blinking blue light would indicate members of one platoon go to the right while a small blinking red light would indicate forces of another platoon go to the left. This is important in the smoke and confusion of an assault.

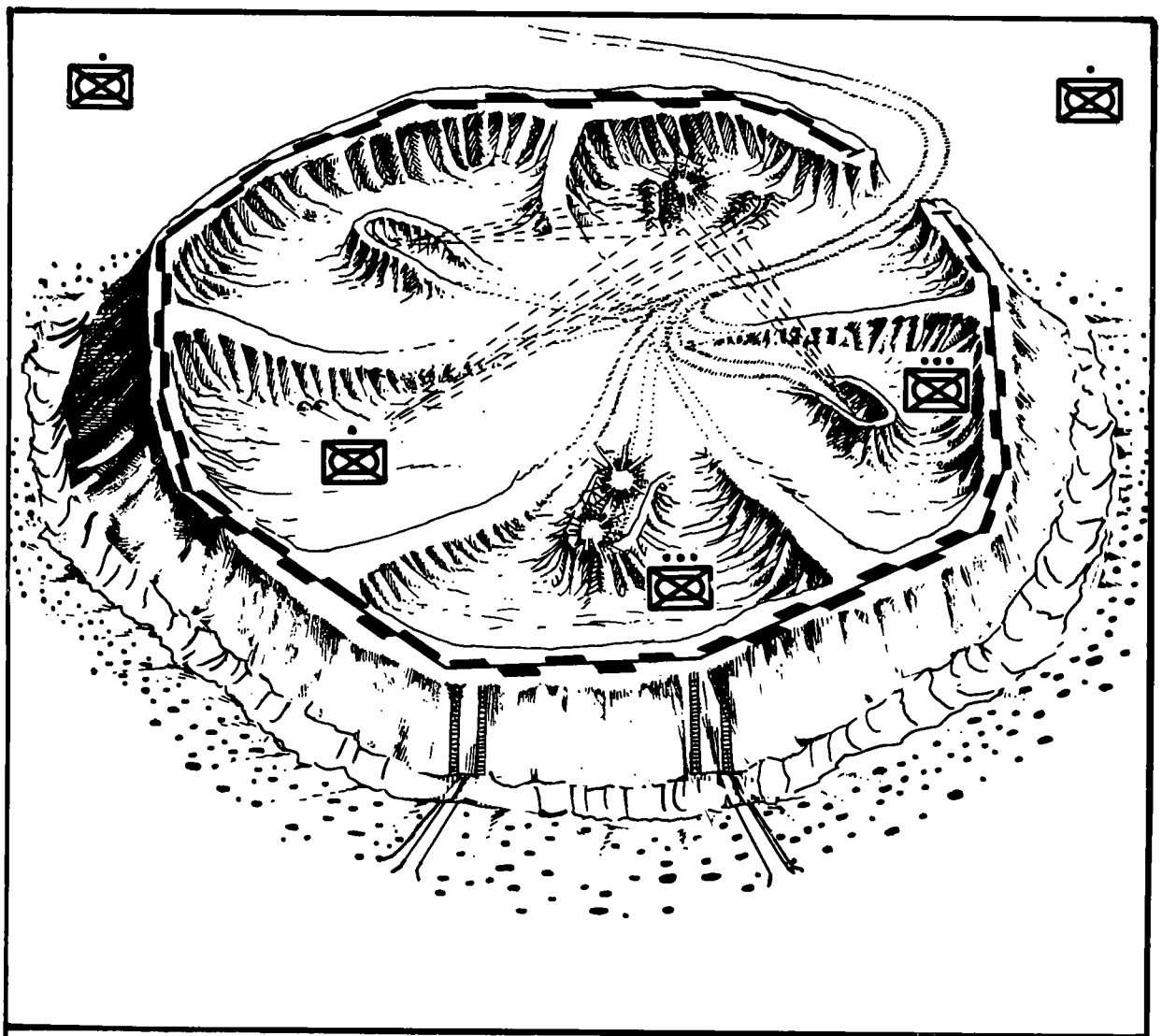


ATTACKING A STRONGPOINT—PHASE I (BREACHING)

Phase II (Assault). Phase II begins as the assault groups abandon their attack positions and charge through the breached minefield and into the strongpoint trenches. Their first step is to set up blocking positions in the trenches and establish a base of fire. The primary task of the element providing the base of fire is to gain fire superiority over the enemy in the center of the strongpoint. The assault groups also try to suppress enemy activity around the entire strongpoint. Squads, working by buddy teams, begin the systematic process of clearing the trench line in both directions simultaneously. To avoid confusion, there should be a predetermined point on the trench line where the two clearing forces will meet. The clearing elements usually stay in the trenches. Their procedure is generally to fire down the trench line, throwing grenades until one goes in or very near the side trenches or weapons positions, whereupon 1 or 2 individuals assault with automatic weapons. The clearing elements must contend with 1-man holes, complete with overhead cover, recessed along the sides of the main trench. After a team takes 1 or 2 of these positions, another team should be called forward to pass through and take the lead. This leap frogging process continues until the trench is cleared. At times it may be expedient to move outside the trench line along the outside of the berm to flank a weapon position and come in on it from a different direction.



ATTACKING A STRONGPOINT—PHASE II (ASSAULT)



ATTACKING A STRONGPOINT—PHASE III (MOPPING UP)

Phase III (Mopping Up). After the trench line has been taken, teams are sent to eliminate any enemy elements of resistance in the center of the strongpoint. Here, tanks and other vehicles may be located behind berms of earth. Also, command and control and supply elements may still remain in trenches or bunkers. The teams sent in to mop up these elements generally move from one covered position to another under the covering fire of friendly forces now occupying the trenches. They make use of hand grenades or explosive charges to toss over the berms and into the trenches and bunkers. This mopping up and consolidation completes the attack on this type strongpoint.

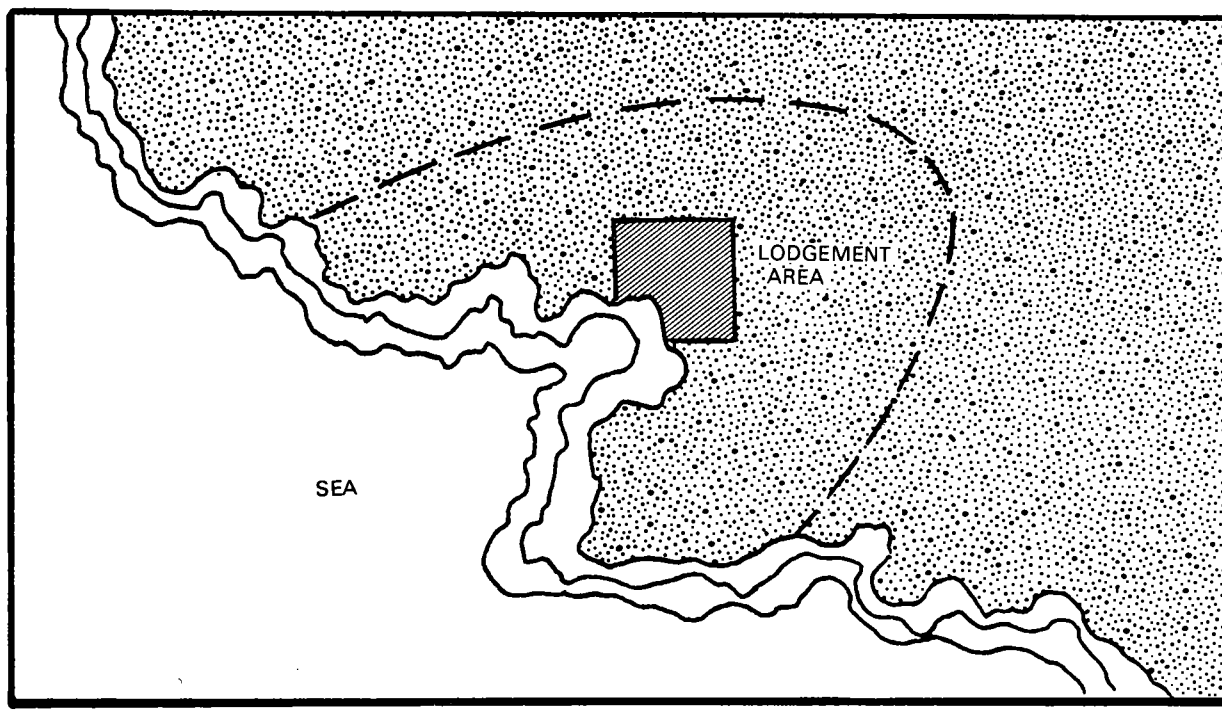
DEFENSIVE OPERATIONS

It is possible, but unlikely, that a US force will be fully deployed in a desert country before an enemy attacks. The more probable situation, assuming a secure lodgement area, will be that part of the force will be in position supporting an allied army, while the remainder is moving in by air and sea. Strategically, the allied force will be outnumbered, so the initial mission will be to gain time until the whole force is present in the operational area. This will require a defensive posture initially, but a defense undertaken so aggressively as to convince the enemy that his offensive action is too costly in personnel and equipment to be worth maintaining. The enemy will be well aware that a US force is arriving in the area, and will make every effort to conclude his operation successfully before the force is fully prepared for battle. The first defensive battle will be critical to the outcome of the operation and it is essential that the mission of destroying an enemy attack be fulfilled. Thus, in the first battles of this war, US forces will defend outnumbered and they must win.

The force may conduct defensive operations at any subsequent stage of the battle for any of the reasons described in FM 100-5. Some part of the force may be required to defend any of the types of important terrain described below:

- *Man-made features* such as ports, key logistic installations, roads, railroads, water pumping stations, airfields, and wells.
- *Natural features,* such as mountain passes, or an occasional piece of dominating ground such as Mount Hermon on the border of Syria and Israel, or the Sollum escarpment near the sea between Libya and Egypt.
- *Tactical terrain,* which need not necessarily be a major feature but one whose loss will inhibit the force in some manner. For example, the loss of terrain relatively close to a lodgement area may hinder the planned rate of buildup.

Except for such cases, the retention of desert terrain normally makes little difference to the final outcome of battle. This *does not* mean that a commander has complete discretion to move his force wherever and whenever he wishes, as this will affect the dispositions of other US forces or allies. It *does* mean that possession of terrain is less important and the destruction of enemy forces is the primary focus. Although it will be necessary to dominate certain terrain or retain freedom to maneuver in large areas of desert, there is no more sense in permanently occupying such areas than there would be permanently occupying a patch of sea. Assuming equal equipment capabilities for both opposing forces, the critical factor in defense will be force ratios involved and the relative state of morale and training of the opposing forces.



A defense of aggressive maneuver at all levels is the best way to destroy large numbers of enemy without being destroyed in the process. If the defending force fails to remain mobile and active, the enemy will easily outflank it and strike directly at vital targets such as the lodgement area. It is almost certain that one flank or the other will be open as were the south flanks of the British and German forces in Egypt and Libya 1940-43. Since it will not be possible to maintain an unbroken line between strategic obstacles, air and ground security forces must be positioned in width and depth to guard against an enemy trying to outflank the defender.

Defense with an unfavorable force ratio relies entirely on the ability of the defending force to identify enemy avenues of approach early in the battle so that units may maneuver to locally change the force ratio in favor of the defender. If the force must defend on a broad front it will be necessary to define enemy avenues of approach and enemy strength on each avenue early, so the defender can concentrate against the most dangerous threat while slowing or containing the enemy elsewhere in the battlefield.

It will be difficult for a brigade or battalion task force to determine where the enemy is going. So, a strong covering force is necessary to cause the enemy to concentrate for a main attack. If he hits the main battle area, advancing on a broad front, the advantage will be with the attacker.

Once a local force ratio of 3 or 4 to 1 has been achieved, the defender can destroy the enemy force. Available obstacles, both natural and artificial are used to slow or contain the enemy or to isolate enemy units in order to defeat the targets and destroy his units one at a time. Forward units block the enemy and canalize him into one or two avenues where he can be engaged from the flank. A reserve can then counterattack by fire or fire and maneuver to destroy remaining enemy.

Mutual support is normally a factor of time rather than weapon range due to large areas to be covered. Gaps may have to be accepted in initial positions between and within task forces; although the ideal is to site units in such a manner that forces in at least two positions can engage an enemy maneuvering on any one of them. This greatly reduces any possibility of defeat in detail. When gaps exist they must be kept under surveillance by some means, and the defensive plan must include provisions for maneuvering to fire on any part of a gap before the enemy can move through it. A unit's area of responsibility must be defined by higher headquarters and should be clearly identifiable on the ground, which, due to the absence of significant terrain features, may require marking by artificial means.

Strongpoints are rare in desert warfare; although they may be necessary to defend an oasis, or, perhaps a mountain pass essential to the defender's scheme of maneuver. When it is necessary to deny terrain to an enemy force, it is far better to initiate the defense well forward of the terrain feature, conduct the defense in depth, and destroy the enemy or force him to break off his attack before he reaches the critical feature.

When it is necessary to delay or withdraw, a desert offers many advantages to the defender. *Long range fields of fire allow engagements at maximum effective range of direct-fire weapons systems, and disengagement before the enemy can begin to close on the defender's position.* However, dust clouds roused by a moving force make it necessary to disengage under cover of smoke or darkness. Even a sandstorm can be used to advantage. Field artillery, air force fighter bombers, and attack helicopters can also be used to allow a ground maneuver unit to disengage and move rapidly to the next position.

When it is necessary to trade space for time, often a counterattack to destroy enemy advance units will do more good than trying to defend longer from an intermediate position.

It is necessary for commanders at all levels to clearly understand the scheme of maneuver and concept of the operation, and what it is they are expected to do, especially should communications fail. Plans must include provisions for alternate means of communication. Routes should be clearly marked and reconnoitered to the extent practical.

Due to the distances involved and constantly changing task organization and deployment, passage of lines will be more difficult to coordinate and control. Extra attention will have to be paid to identification of vehicles, routes of passage, signals, and coordination of movements.

Deception should be a part of all desert retrograde operations. The object of deception is to conceal the fact that a retrograde operation is going to take place and that units are thinning out. Smoke can be used, dummy positions can be prepared, false radio messages can be transmitted, and even dust clouds can be used to deceive the enemy.

FUNDAMENTALS OF DEFENSE

The fundamentals of defense are fully described in FM 100-5 and How-to-Fight manuals appropriate to each level of command. Some points to remember in desert operations as they apply to fundamentals of defense, are described below:

Understand the Enemy. The enemy has weaknesses. His equipment is not perfect and many of his vehicles overheat in desert climates. He may have a great many towed field artillery pieces. It takes longer to position and displace towed field artillery, thus increasing opportunities for counter-battery fire. Main battle tanks have limited main gun depression, and enemy crews may have to compensate for this by halting to fire on forward slopes thus exposing themselves. Other weaknesses in equipment, tactics or some aspect of enemy operations, may be detected as the campaign progresses.

See the Battlefield. Reconnaissance and security units and force surveillance systems must focus on:

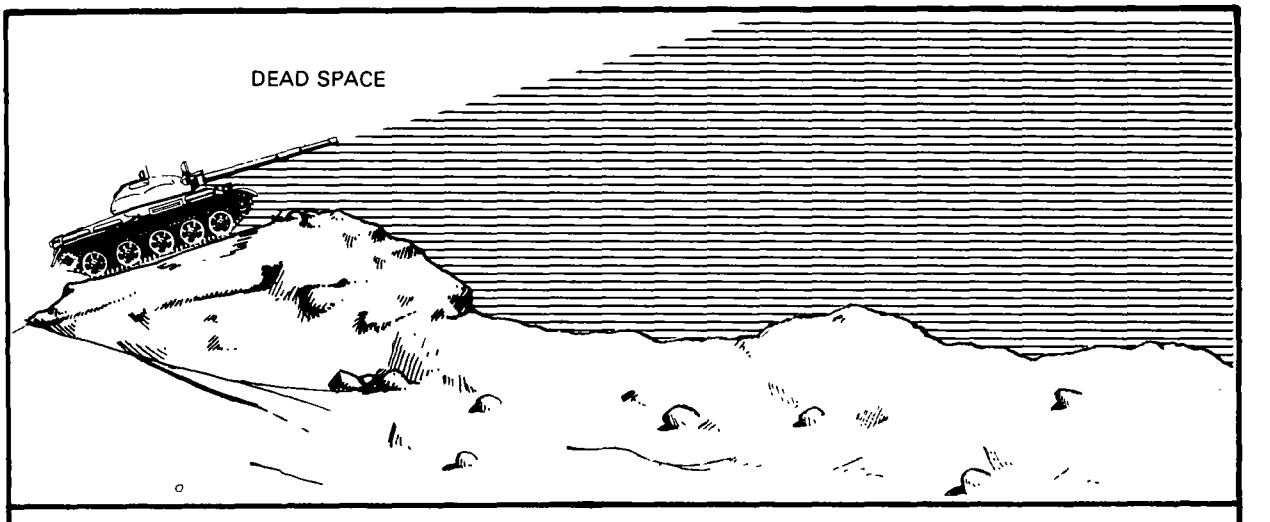
What is the enemy's short-term objective?

What are the enemy avenues of approach, and what force is employed on each of them?

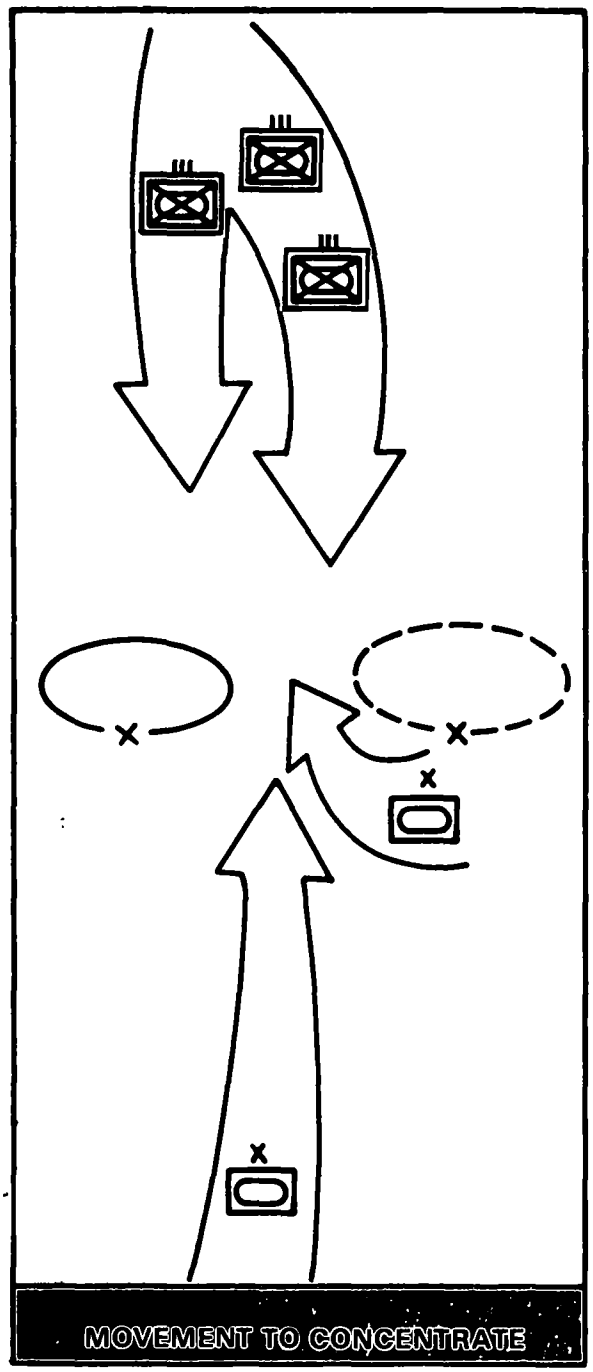
Are the apparent movements real or feints?

As soon as these have been established the commander will be able to maneuver to destroy the enemy. Until they are confirmed he can do nothing more than react to enemy initiatives. This is dangerous in any circumstances and doubly so in the desert, as the side with the greatest potential for maneuver is more likely to win.

Direct-fire weapons must be used to their maximum effective range both by day and night. Limitations in night vision equipment cannot be allowed to reduce depth or frontages; so plans for field artillery or mortar illumination must be made for defense at night.



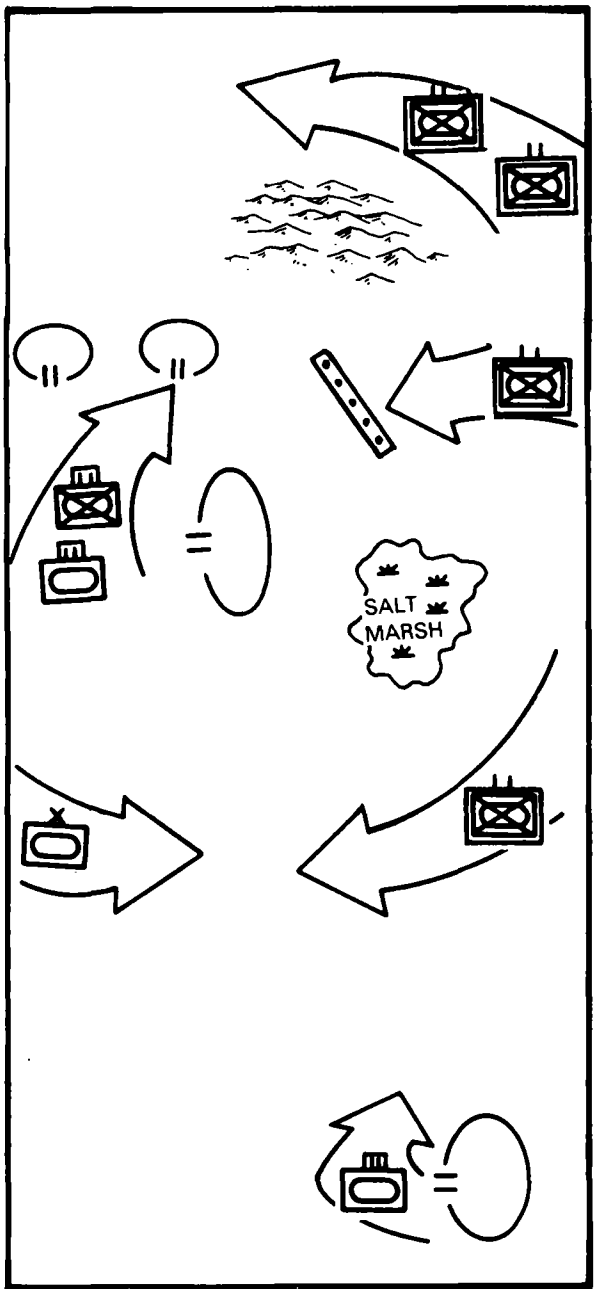
THREAT EQUIPMENT LIMITATIONS



Move to Concentrate. Considering the requirements of mutual support and the need to avoid defeat in detail, a battalion task force is the smallest viable entity in desert operations. It is essential that all elements of a force retain their tactical mobility together with efficient communications so that they may react immediately to changes in the commander's plans. Each individual weapon must be sited in a number of firing positions, even though vehicular movement may be exposed to air attack. Infantry fighting vehicles must remain in positions where they are concealed, capable of giving fire support to the dismounted squad, and available for immediate remounting.

Fight as a Combined Arms Team. Combined arms teams are essential to give the commander the capability he requires to fight the defensive battle. Defending forces orient on primary enemy approaches but units must also be prepared for attack from any other direction. It is neither possible nor necessary to have maximum firepower in all directions, provided that weapons can be moved to threatened areas before the enemy reaches them. Air cover or an air defense umbrella is necessary for a successful defense.

Exploit the Advantages of the Defender. It is rare to find positions where any *substantial* part of the unit area of operations can be protected by natural obstacles. This requires extensive use of artificial obstacles, depending on time, personnel, and combat service support available. Such obstacles must be large, or they will be bypassed by the enemy without difficulty. Therefore, available engineer effort is best expended on one or two obstacles laid out in accordance with the brigade or division defense plan, rather than on numerous small ones. Obstacles are used to divide the enemy force so as to improve local force ratios, and to slow the enemy advance thus permitting a flank attack. Conventional minefields must be clearly marked on the friendly side and recorded to avoid unnecessary losses if friendly forces later maneuver over the area.

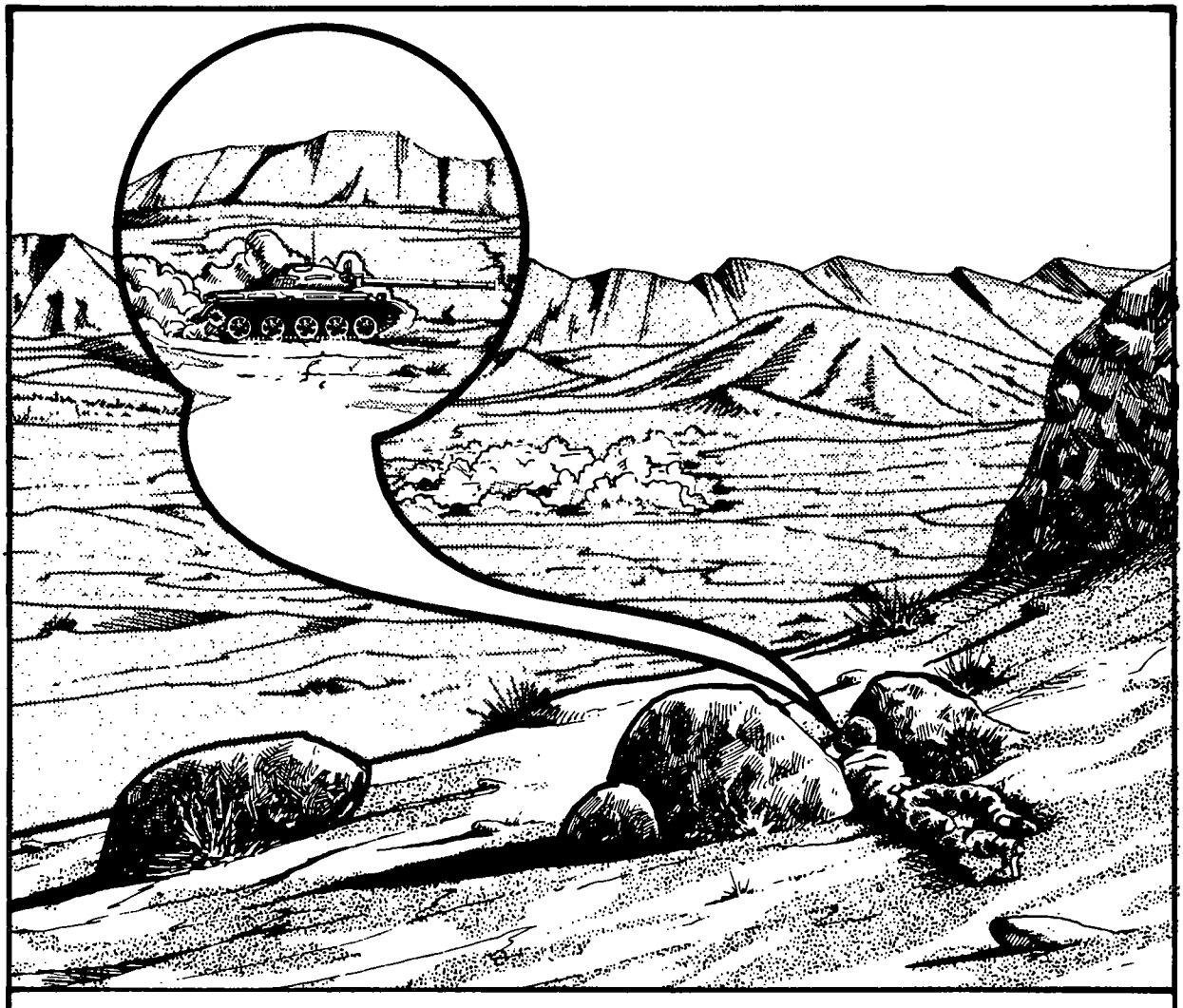


EXPLOIT THE TERRAIN

ENVIRONMENTAL CONSIDERATIONS

In the desert, it is necessary to modify techniques of defense described in How-to-Fight manuals applicable to each level of command according to the fundamentals described in the preceding paragraph, the mission, and environmental considerations which are described below.

Observation. The enemy will try to attack with the sun low and behind him so as to dazzle the defender. The defender's observers must be as high as possible above the desert floor in order to see the advancing enemy as soon as possible.



OBSERVE FROM HEIGHT

Active light sources can be detected from great distances, especially during nights with low ambient light. Positive control of active sources must be maintained until battle is joined. Even then, the force equipped with passive devices will have the advantage over the force which is not.

Heat from combat vehicles can give an enemy using thermal imagery devices a complete picture of the defensive scheme. So, combat vehicles should not prematurely occupy battle positions at night.

Sandstorms. Sandstorms, especially if blowing from the enemy, may be used by him to hide an offensive operation. When this is the case, units should occupy battle positions immediately before the storm arrives and remain there until it ends, ready to fire and maneuver against the attacker following the storm. If vehicle patrolling is possible, a scout platoon or similar unit should cover all gaps, preferably moving in pairs, and on straight lines in view of navigational difficulties.

Terrain. From the point of view of a defending brigade or battalion task force commander, avenues of approach will often seem unlimited. Long range observation must be maximized and scouts employed well forward to offset this problem. Radars should also be extensively used to provide early warning. Artificial obstacles can help to limit avenues of approach, but as previously mentioned, they must be large to have any effect. It is necessary to identify the enemy's main effort early in order to move to concentrate.

Lack of concealment, especially from the air, prohibits units from occupying firing positions until just before engaging the enemy. Combat vehicles must displace immediately after engagement or risk destruction. Because of frequent displacement, routes between battle positions should be reconnoitered and marked when possible, without revealing the scheme of defense. Smoke must be frequently used to conceal movement.

Commanders must employ mech infantry in the way that they can best contribute to the fight. They may be deployed either mounted or dismounted depending upon the mission and/or terrain. For example, if a tank-heavy company team is given the mission to engage a threat mechanized force at long range, the mechanized infantry cannot contribute to the long range fight; consequently they may well remain mounted in a well-concealed hide position. However, in certain locales, desert terrain is also hilly, and sometimes broken up. Therefore, their shorter range weapons can be used effectively.

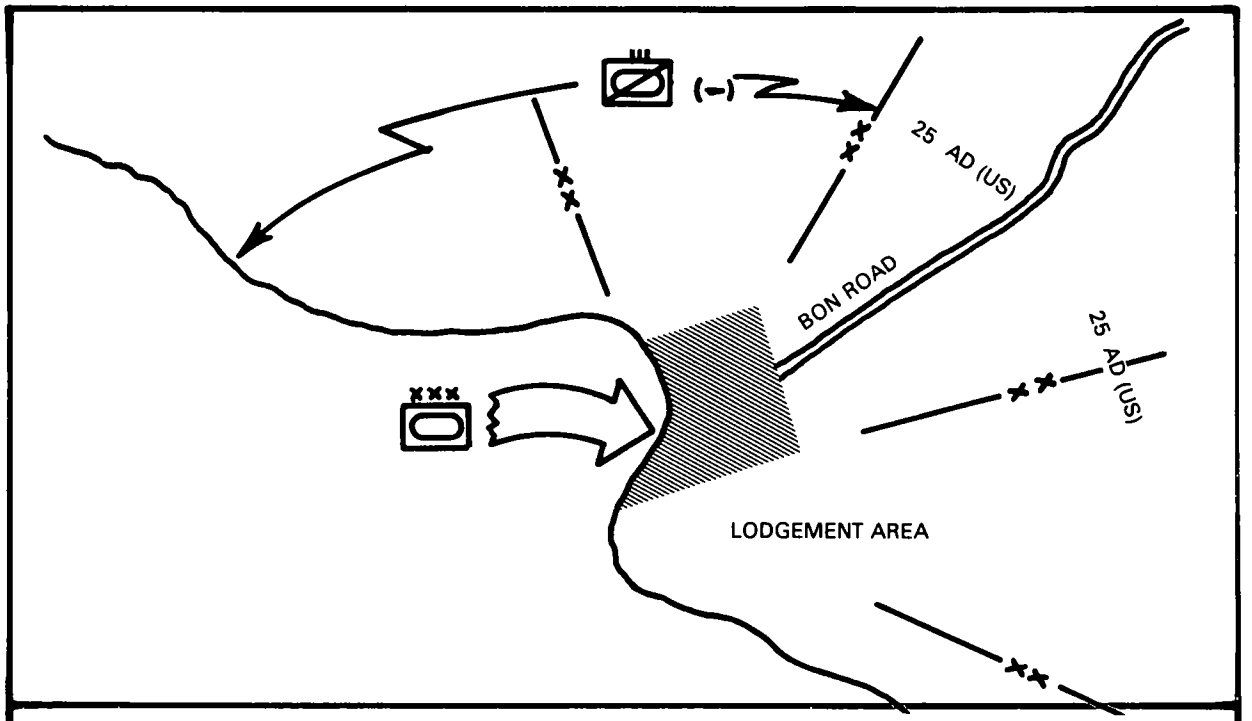
Fires. As previously described, the desert offers excellent fields of fire. Tanks and heavy antitank weapons should be sited to take advantage of their long range and accuracy. Firing *accurately* and *first* is most important in desert operations. Because it is easy to become disoriented, it is often necessary to mark sectors of fire on the ground with poles, or rocks if available. Indirect fires are used to slow the enemy advance, to suppress enemy weapons and observers, and to conceal movement between positions with smoke.

Defensive operations in deserts are characterized by long range engagement with tanks and ATGM's.

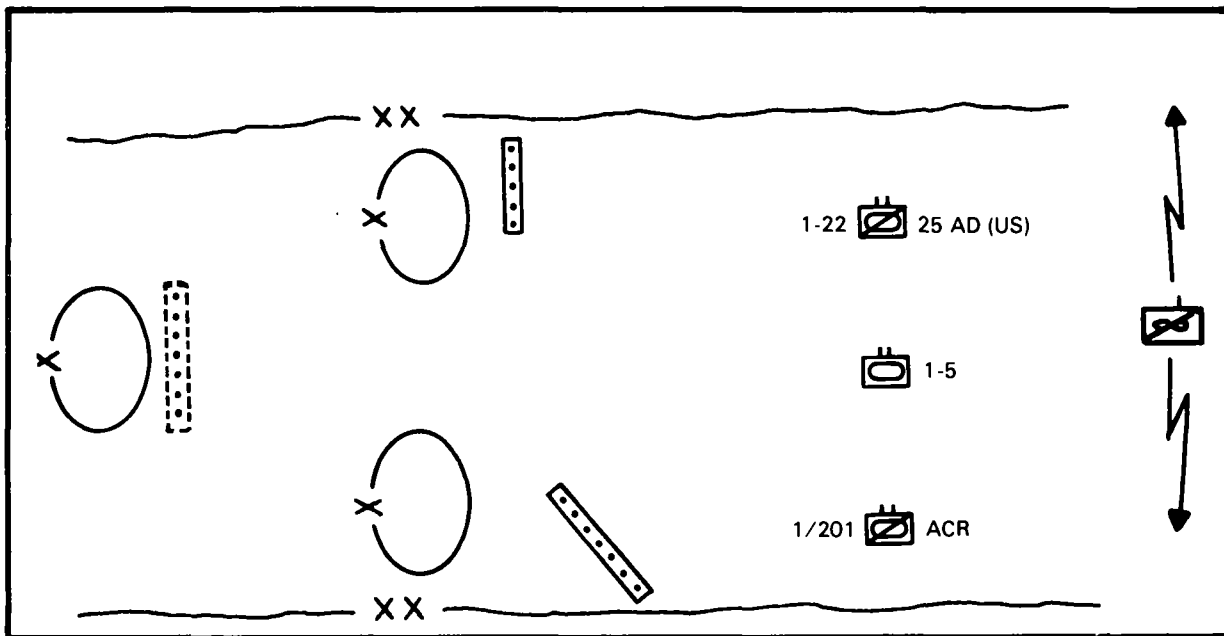
DEFENSE EXAMPLE

The following example shows *one way* in which a division and a brigade may defend in the desert. Units depicted here are defending on almost featureless terrain against a larger enemy force. Defensive operations are altered to fit the terrain as it becomes more broken and avenues of approach are more easily identified. It is important to remember that in the desert, offensive maneuver may be the best defense.

General Situation. The 25th Armored Division is defending a part of a corps lodgement area. Thus far, the corps armored cavalry regiment (ACR) and the 25th Armored Division are the only units that have been deployed. Remaining units of the corps are still arriving in country. Once the force is strong enough, the corps will go on the offensive.



SECURITY FOR LODGEMENT AREA



DIVISION DEFENSIVE SECTOR

Special Situation 1—The Division. The division has been assigned a sector covering one of the very few supply routes available to an attacking enemy force. Allied forces on the left are defending the remainder of the lodgement area. The ACR (-) is covering in front of the allied divisions. One of its squadrons is deployed under control of the division. The division commander has also deployed the division cavalry squadron and a tank-heavy battalion task force in the covering force area. The entire covering force (two cavalry squadrons and the tank battalion force) forward of the division is under control of the assistant division commander (maneuver). The mission of the covering force is to establish contact with the enemy; destroy his reconnaissance screen; determine his strength, disposition, and avenues of approach; and begin attrition of the main body as early as possible.

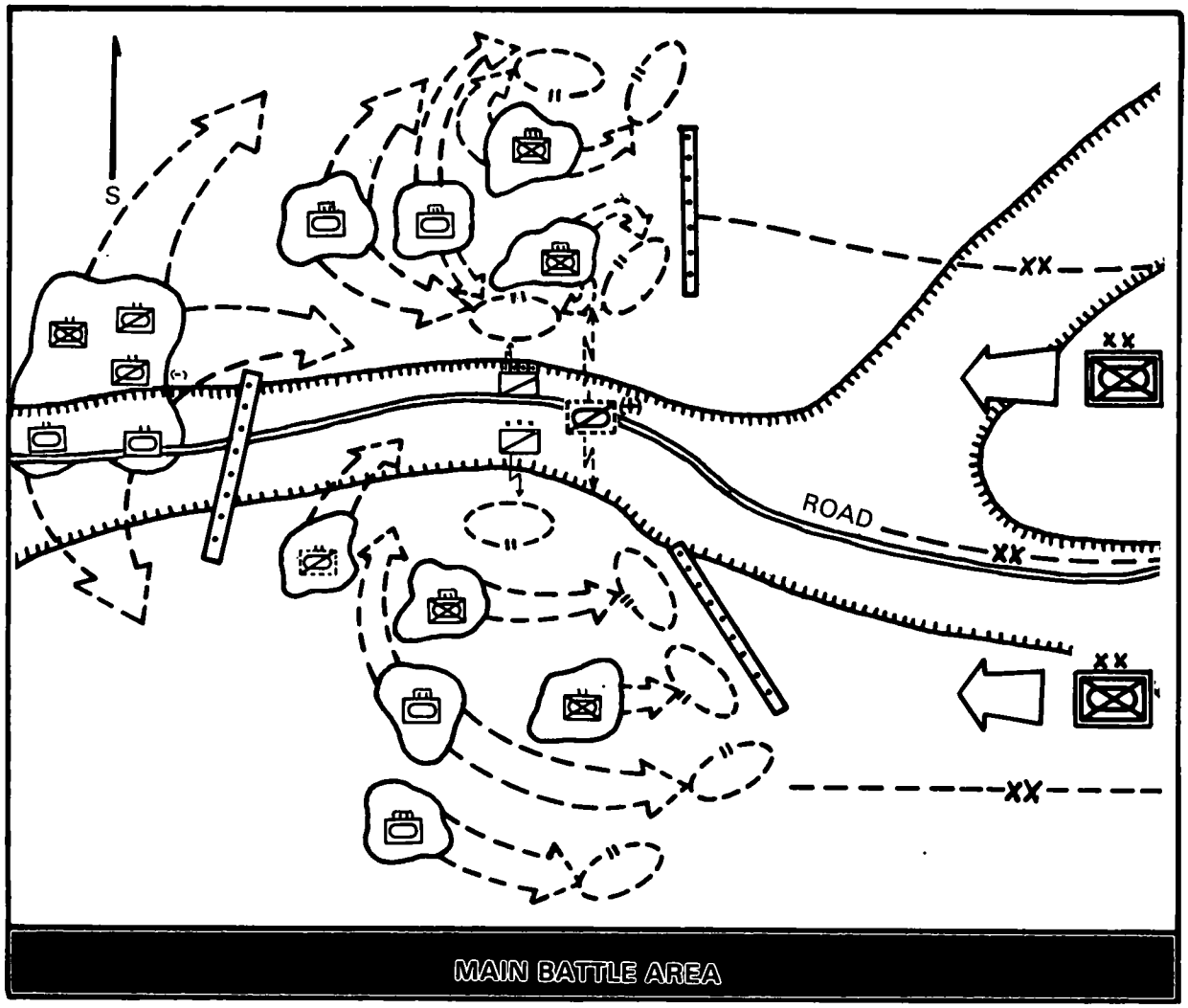
In the main battle area, the division commander positioned 2 balanced brigades forward, each with 2 tank and 2 mechanized infantry battalions. A brigade of 1 tank and 1 mechanized infantry battalion is initially retained in reserve.

There are no natural avenues of approach into the division sector. A minefield is employed in front of each of the two forward brigades, using all available minelaying resources to do this. The object of these minefields is to slow a part of the enemy and force him to deploy and expose his flanks, thus allowing forward brigades to engage him as he maneuvers. Since obstacles must be large to be effective, the division commander assigned the two minefields as first priority of work. The minefields have been completed and a third field of similar size in front of the reserve brigade is under construction.

Because there is virtually no significant terrain in the division sector, forward brigades have initially deployed their battalions in assembly areas behind battle positions located to cover the minefields. The brigades can move laterally from these assembly areas to attack the enemy from the flanks once enemy forces commit themselves to bypass the obstacles. Initial positions will allow maneuver of battalion task forces to meet an enemy attack from any direction.

The brigades, each with a frontage of approximately 10 kilometers, are separated by a 15-20 kilometer interval, initially covered by two scout platoons from the reserve brigade, reinforced with ground surveillance radar. As the covering force withdraws, a reinforced cavalry troop will relieve the scout platoons while the remainder of the covering force initially join the reserve brigade. Even though the brigades are separated by a relatively large interval, they can be mutually supporting by maneuver.

The reserve is located approximately 30 kilometers to the rear of the FEBA and facing the interval between the forward brigades. The mission of the reserve is twofold. First, to maneuver to attack any enemy force bypassing forward brigades, and second, to counterattack an enemy force that has been slowed and weakened by forward brigades. Due to the vital importance of combat service support in this terrain, the mechanized infantry battalion from the division reserve has been given the mission to protect the DISCOM on order.



MAIN BATTLE AREA

Special Situation 2—The Covering Force. The covering force deploys to achieve maximum surveillance over the entire division CFA. Cavalry troops and tank-heavy company teams are deployed throughout the sector in a series of positions that have overlapping fields of observation. Mounted patrols and the aeroweapons platoon of the divisional armored cavalry squadron are used to cover intervals between units. The divisional squadron's air cavalry troop, less the aeroweapons platoon, is initially deployed forward of ground maneuver units to see the enemy as early as possible.

Covering forces position themselves on slightly higher ground, several kilometers apart, yet still maintain overlapping surveillance. Long range weapons of the cavalry squadrons and tank battalion task force allow coverage of the majority of each sector with direct fire, in spite of the large distances involved. Units are placed on listening silence until they sight enemy. Maximum use is made of directional radio antennas to avoid electronic detection. Radars scan at maximum range from different positions for short periods at irregular intervals.

Covering forces plan to destroy enemy reconnaissance groups moving ahead of the main body at long range. Units remain in position until the enemy main body is sighted and then defend, delay, or attack as necessary, maintaining contact with the enemy. The covering force attempts to identify enemy main avenues of approach (which may be simply a general direction) and confuse the enemy as to the exact location of the main battle area, using long range field artillery and direct fire and destroying isolated elements of advance guards. Once the enemy is within range of forward brigades, the covering force passes into the main battle area and joins the division reserve.

Special Situation 3—MBA Brigade. The commander of the southern brigade intends to make maximum use of the mobility afforded by the terrain to destroy the enemy with a combination of long range direct and indirect fires and a series of offensive thrusts into the enemy's flanks.

The brigade consists of 2 mechanized infantry battalions and 2 tank battalions. The brigade commander has task organized into 2 tank-heavy and 2 mechanized infantry-heavy task forces. The mechanized infantry-heavy task forces are initially positioned in assembly areas to the rear of their intended battle positions. In order to confuse the enemy as to the actual locations from which friendly units intend to fight, battle positions are not occupied until the last possible moment. As the enemy approaches within range, these two task forces move into battle positions covering the minefield.

The brigade commander positioned the two tank-heavy task forces in depth, ready to maneuver in either direction to attack an enemy unit bypassing the minefield.

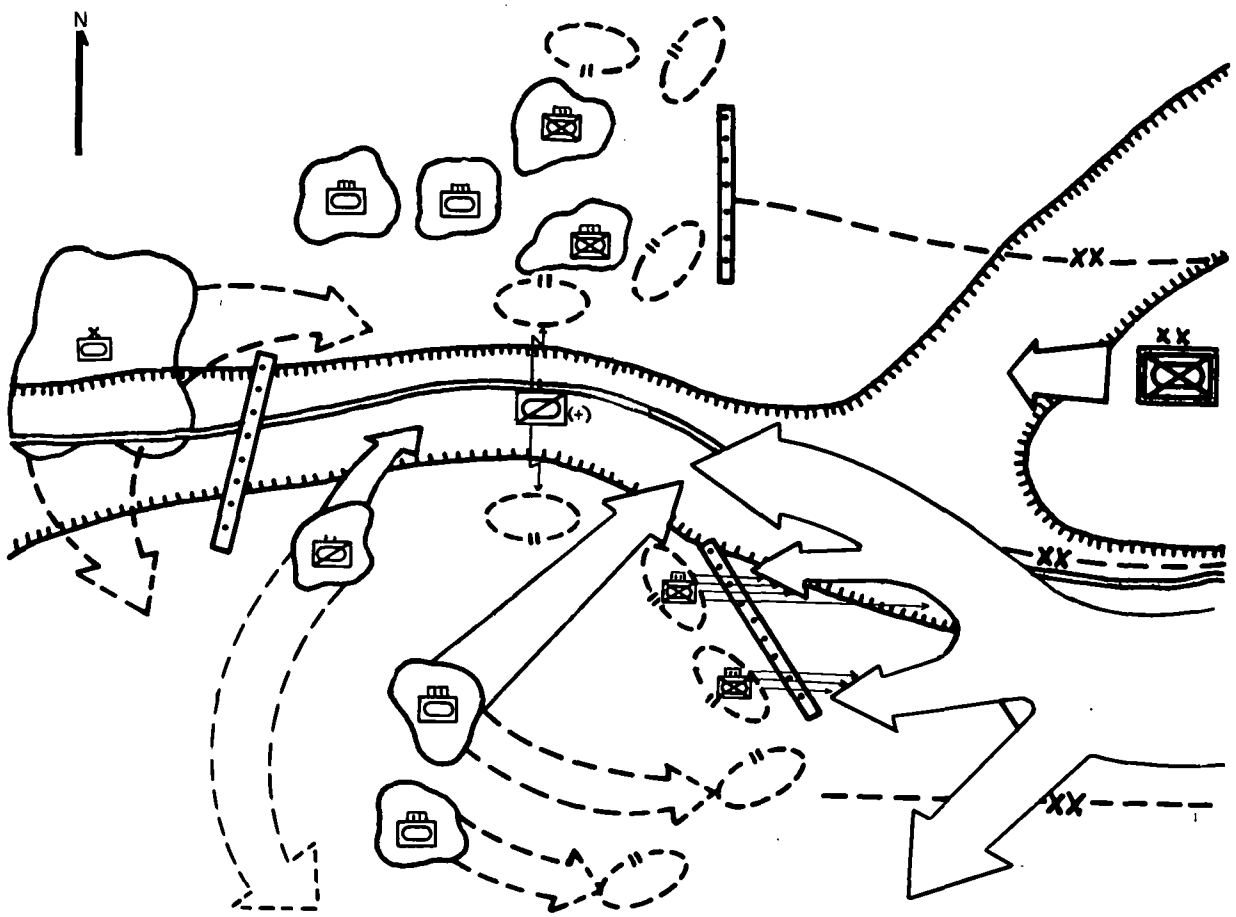
All battalion scout platoons are located 5-10 kilometers forward of the obstacle to assist passage of covering forces into the MBA, facilitate hand off of the enemy to the brigade, and to provide early warning. For this purpose, the platoons are placed under control of a combat support company commander from one of the tank-heavy battalion task forces, who moves forward with the platoons to control their activities.

After careful consideration of the terrain in his sector, the brigade commander sited the minefield to encourage the enemy to bypass to the north through the interval covered by the reinforced troop of the division armored cavalry squadron, once the minefield is discovered. During his analysis of the situation, he decided that an enemy force attacking astride the supply route would be reluctant to allow a part of his force to bypass to the south, since it would become too far separated from the main body and be subjected to defeat in detail.

The mission of the mechanized infantry battalion task forces is to slow the enemy and to prevent him from breaching the obstacle. If the enemy attempts to bypass, mechanized infantry can engage him from the flank. The tank-heavy task forces can move to concentrate and counterattack as the enemy force extends its flank to bypass the two forward units. If the enemy presses the attack with additional regiments, the division reserve is available to reinforce the forward brigades and the entire division can be concentrated against the enemy in the interval between the two forward brigades.

Both the division and brigade plans allow the commander to see the enemy early, and provide for concentration once the enemy's intentions are determined. The use of artificial obstacles allows the combined arms team to exploit the advantages of the defender.

Terrain is used to best advantage, long range fields of fire and observation are optimized; maximum use is made of maneuver space. Adequate dispersion is provided and intervals are covered by cavalry and scouts.



MOVEMENT TO CONCENTRATE

Special Situation 4—A Night Laager Technique. In the typical desert environment of little or no vegetation,the night time security problems are different than those encountered in other environments. Not only must the unit contend with dismounted infantry armed with RPG type weapons, but it must also contend with enemy armored forces (tanks and ATGMs) attacking or raiding at night. *Often, the value of dismounted OP/LPs becomes questionable.*

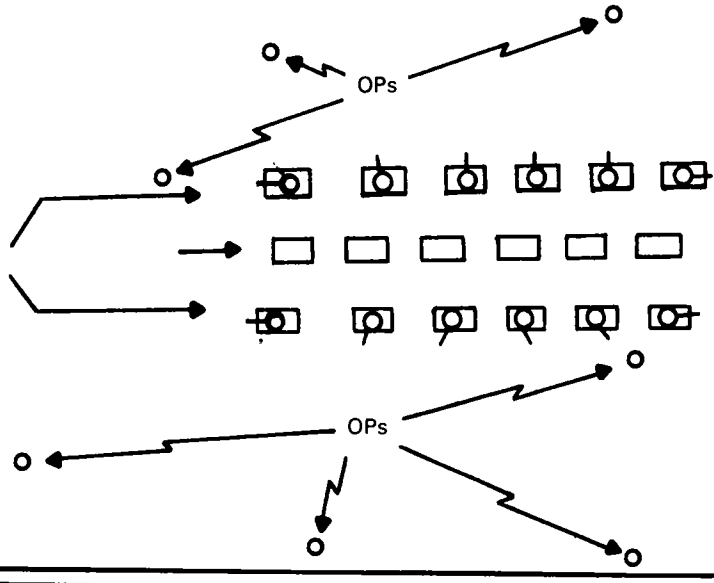
The following example therefore, illustrates one technique that may be used for the night laager of a company team. This example shows a company team of 2 tank platoons and 1 mech platoon.

This technique has the advantages of:

Good security.

Excellent control.

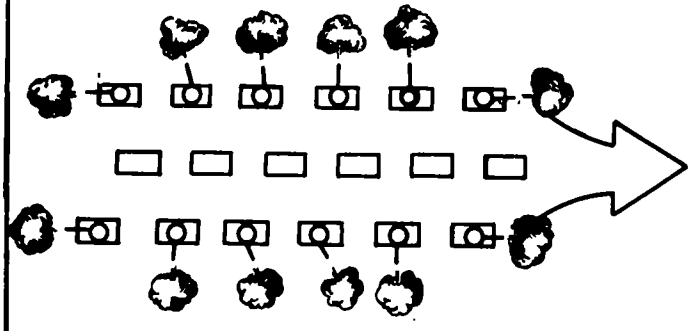
Maximum rest.



REFUEL FORMATION

NIGHT LAAGER DEFENSE

1. The company is formed up as shown, with tanks on the outside and APCs or other "soft" vehicles on the inside for protection. The company moves to a location for refueling, re-arming, and necessary maintenance.
2. OPs are established to provide early warning.
3. Upon completion of resupply and maintenance activities, the company usually relocates to a new position to remain overnight.



4. After relocating, the company stops for the night in the same formation.
5. All personnel are mounted; no OPs are established, one man is awake in the turret of each vehicle. *Anyone observed dismounted is assumed to be an enemy.*
6. If the company is attacked, all tanks immediately open fire in all directions, and, on command of the company commander, the company moves out—normally in the direction the columns are facing.
7. After moving away from the immediate threat, the company halts, and the company commander decides how to deal with the situation

COMBAT SERVICE SUPPORT

A desert provides nothing to sustain a force. It is a tactician's dream but a logistician's nightmare.

There are no natural assets, not even water.

The effects of the environment on equipment are severe, requiring increased levels of support to maintain a standard level of efficiency.

Distances between units, and lines of communication are long.

Due to the importance of combat service support units, they are primary targets.

Maneuver units often consume greater quantities of petroleum products (fuels, oils, and greases) and ammunition than they would normally need in temperate climates. It is necessary to haul more, farther, in difficult conditions to accomplish the same missions.

CONTENTS

US Army forces in the desert operate at the end of a long, perhaps tenuous line of communication. Cargo space must not be wasted to provide all the comforts of home. A significant difference in living standards between rear area support personnel and those in forward combat areas must be avoided since this can affect morale and weaken the ability of combat units to resist psychological warfare. Transportation priority must be given to minimum essential materials and the support base should be austere.

BASE DEVELOPMENT PLAN

As described in chapter 1, US Army forces deploying for operations in a desert environment should expect to begin operations from a lodgement area. When this is the case, it is necessary for the headquarters deploying the force to prepare a detailed base development plan. How the plan is developed will depend on a number of factors:

The Mission and Size of the Force. The size of the force will depend on its mission and the operations it is expected to conduct. Size of US Army forces deployed for desert operations could vary from an independent reinforced battalion task force or brigade to simply "show the flag," up to an independent corps, or army for full scale operations.

Security of the Lodgement Area. A lodgement area will probably be secured by allied forces or US Marines before deployment of US Army forces into the operational area. However, it may be necessary to use US Army forces, either airdropped or airlanded, to secure a lodgement area.

Transportation of US Army Forces into the Lodgement Area. It is probable that initial forces will be transported by air and follow-on forces by sea. Another possibility is that initial forces will be transported by air while equipment of follow-on forces will be transported by sea with follow-on personnel being transported by air

Strategic Lines of Communication (LOC). The initial strategic LOC will probably be an air LOC. However, at some point in the operation a sea LOC will be established to convey the bulk of the supplies, supplemented by an air LOC to haul time sensitive items.

Theater Lines of Communication. Lines of communication within the operations area should be analyzed before selecting the lodgement area. The analysis should include ports available, airfields throughout the operational area, road nets, and railroads. It may be necessary to stage engineer construction units into the operational area early to improve existing facilities and LOCs or to construct new ones.

Local Resources. These are extremely important as they will affect logistics planning. Typical information about resources in the operational area that should be obtained before base development planning includes.

- Airfields.
- Water sources.
- Fresh rations.
- Labor supply.
- Construction materials and available equipment.
- Material handling equipment at ports and airfields.
- Local hospitals, maintenance capability and storages sites.
- Local power supply to include type and equipment.
- Railroad rolling stock and gauge.

After consideration of the factors listed above, the lodgement area is selected. Ideally, a lodgement area should have a deep water port and airfield suitable for heavy strategic airlift, located at the end of an adequate road or rail system suitable for an intratheater LOC. Once the lodgement area has been selected then LOC-port units can be specially tailored for early deployment to the operational area.

THE THREAT

The threat to the logistic system includes air attack; attack on lines of communication and installations by conventional forces, guerrillas, or enemy long range patrols; or even hostile action by the local population such as theft, sabotage, labor problems, or noncooperation. To minimize this risk:

Stocks should be kept to the minimum and concentrated in selected areas so that they can be easily guarded. However, all stocks of any one item should not be kept in the same location.

An area protection force may be used for the lodgement area. This will require a Support Center, Rear Area Operations if several units are involved.

Requirements for civil labor should be kept to the minimum if possible; logistic systems should be capable of operation without the assistance of the local population.

Plans for movement of supplies and personnel over the beach must be developed in case all or part of port facilities are damaged.

Plans to replace any civilian labor with military labor should also be prepared.

CORPS SUPPORT COMMAND

A corps support command (COSCOM) deploying to support desert operations must be carefully tailored to meet the needs of combat forces operating in a harsh environment. Requirements for long haul truck companies, engineer construction battalion, water production units, and LOC-port units previously described must be carefully weighed. A shortfall of these units could significantly impair combat operations. Organization of the COSCOM should be planned based on the factors described in the previous paragraphs, with particular attention given to:

Number of troops to be supported.

Quantity and types of equipment to be maintained.

Tonnage to be handled.

Available local resources and labor force.

Types of units to be deployed to the theater of operations.

The organization of the COSCOM and a description of its tasks are provided in FM 54-9, *Corps Support Command (COSCOM).* Initial corps forces entering the theater can be supported by a Forward Area Support Team of a Division Support Command and tailored COSCOM units not normally organic to a division, which must be specified in the deployment plan. Once initial forces have

arrived in the theater, additional tailored elements from the COSCOM must immediately follow to minimize the requirement for the DISCOM to operate such activities as ports or airheads.

DIVISION SUPPORT COMMAND

In view of the distances involved in desert operations, it may be necessary to subdivide the Division Support Command (DISCOM) area into smaller support areas, one area operating in support of each brigade, and perhaps another supporting other divisional support units. When deciding to do this, the division commander must carefully consider the security implications involved.

As previously mentioned, combat service support units are high priority targets for any desert enemy. In most cases, DISCOM units will not be able to provide for their own security, considering the many ways in which they could be attacked. Air defense protection must be provided. It may even be necessary to provide a maneuver unit to secure DISCOM elements. Nearby maneuver units can also be designated to move to their defense; attack helicopters are especially suited for this purpose; and on-call fires should be planned by nearby field artillery units. Any pipelines in the division area must also be secured by any means at hand. Observation helicopters can be used to patrol pipelines.

Stocks should be kept as mobile as possible in the event rapid displacement is necessary. Stockpiling off vehicles must be held to a minimum, as should stockage levels. To the extent practical, supplies located forward of the DISCOM area should be stored aboard vehicles to minimize the possibility of having to leave them behind. For this purpose, a force operating in the desert should be augmented with additional transportation units.

TRAINS OPERATIONS

Trains operations can be complicated by the following factors:

Supply. Consumption rates must often be developed after the force has operated for some time in the area. Water has to be found, purified, stored, and transported.

Maintenance. There will be a greater demand for such items as filters, oils, and lubricants. More class IX stores are required than normal and the work load on maintenance units is much greater.

Concealment. It is difficult to conceal trains areas. These are soft targets in any environment and are high priority enemy targets as their destruction (especially water and fuel supplies) effectively cripples the force.

Distribution. Maneuver units may be farther apart, both in width and depth, than in temperate environments. They move more frequently and also faster. Lines of communication are longer. Terrain away from main supply routes may be such that it is only passable to cross country vehicles, and then only with reduced payloads. Lack of significant terrain features may increase navigational problems, requiring qualified navigators or local guides.

Trains Composition. Composition of company team, battalion task force, and brigade trains is generally as described in FM 71-1, FM 71-2, and 71-100; however, some modification in operating procedures is

necessary. These are described below:

Company team trains. Company team trains should be echeloned into combat and field trains to provide for dispersion. They must have the same potential mobility as the company team they are supporting. Combat trains must be as small as possible and rely on the company team for protection. Combat trains move behind the company team during the day, perhaps one tactical feature (4,000 meters at the most) to the rear. They close up at night. If the company team is not moving and not expecting an enemy attack, trains should be within the company team perimeter. It is desirable that at least one member of each vehicle in the company team trains be a competent navigator as vehicles may move individually. Company team field trains may locate with battalion task force trains but must be responsive to the needs of the company team commander.

Battalion task force trains should also be echeloned into combat trains and field trains, as are company team trains. It is unlikely that both combat and field trains will be overrun simultaneously by the enemy. The fact that some support operations will not be as efficient as if they were centralized must be accepted. Since the only available defense against an enemy maneuver unit or indirect fire will probably be by immediate movement, both echelons must be totally mobile.

Due to demands on transportation the battalion task force commander should consider very carefully if he can afford to use dedicated mess trucks for company teams. It may be preferable to rely on vehicle crew feeding of combat rations and use mess trucks for other tasks such as carrying additional water supplies in locally fabricated pods.

The location and movement of battalion task force trains are governed by a number of factors, some of which conflict, and which can only be evaluated depending on the local situation. It is impossible to prescribe specific guidelines for the location of battalion task force trains because of variations in desert terrain as described in chapter 2. Much will depend on cover and concealment available, mission of the supported force, and distances over which the force is expected to operate at a given time and place. The primary principle is that they should be as close to task force forward elements as possible. Some general points to consider are:

- Trafficability in terms of travel time to company team locations.
- Distance to the nearest company team that may be called upon, to defend them.
- Need to avoid inhibiting maneuver of company teams.

Spacing of individual vehicles is a compromise between the need for control and the requirement for dispersion against air attack. When halting it may be necessary to close up to the battalion task force or drop farther back as the position at the halt must provide the maximum concealment available. Vehicles are parked 100-200 meters apart, as irregularly spaced as possible, and organization of the trains area must provide the maximum security against ground and air attack.

Brigade trains. Due to the fluidity of desert war, brigade trains should be able to move on short notice, especially if the brigade is to withdraw or has been outflanked. Maintenance units are able to move within this time frame; although it may mean immobilized vehicles being destroyed and left behind, but it is not possible in this case of the medical clearing station. There are two alternatives available. The medical company may remain in place relying on the provisions of the Geneva Convention (a fairly frequent occurrence in the North African War where battle ebbed and flowed around medical units), or the standard medical evacuation

system must be altered so patients are not held in the brigade trains area.

As in the case of battalion task force trains, it is impractical to provide specific guidance for brigade trains location. However, as a rule of thumb, the actual distance must not exceed that for a cargo vehicle to move forward, supply a maneuver unit and return to the trains area, all under cover of darkness. Brigade trains should be located to take advantage of any available concealment, and should if possible, be located near or around a water source. No matter where the water source is located it should be guarded.

SECURITY OF MAIN SUPPLY ROUTES

Enemy ambushes on main supply routes are always a threat in desert operations. Enemy patrols may also place nuisance mines on routes, especially at critical points such as defiles. The following actions may be taken to minimize the threat to supply routes:

Route Patrols. The route may be patrolled before immediate use and at irregular intervals when not in use. Helicopters are good for this task as they are cost effective in personnel and time; crews must dismount for close inspection of the route. The terrain on each side of the road should also be covered, to a depth of 3,000 meters on each side. If the route is patrolled by surface vehicles they must have maximum protection against mine blast. Military police patrols also provide a resource for continuous monitoring of supply routes.

Observation Posts. OPs can maintain a constant presence along the route but are relatively expensive on manpower. They should be sited so that their surveillance equipment will interlock in conditions of poor visibility.

Convoys. It may be necessary to form armed convoys, escorted by vehicles from a maneuver unit. The escort should include air defense weapons, and one or more helicopters. Convoys should not be scheduled at regular intervals.

SUPPLY

Time and distance factors developed by experience in other terrain are of little value in the desert. The absence of roads in forward areas, navigation problems, vulnerability of trains and supply installations to attack by ground forces or aircraft, sandstorms, and wide dispersion all require a different appreciation of time for resupply operations.

Classes of Supply. Requirements for supplies vary according to class from that of temperate climates. Differences that may be expected in any desert are described as follows.

Class I. The use of mess trucks is inadvisable in the desert if troops are within range of enemy ground troops equipped with surveillance equipment or if the enemy has local air superiority; moreover, rations that require refrigeration or need quantities of water for their preparation should be avoided. No change need be expected in tonnage of food consumed, but some items such as fruit (fresh or canned) will be in high demand. It may only be possible to provide prepared meals to groups smaller than complete units due to the size of frontage occupied. Every vehicle should carry 2 to 3 days' supply of combat rations and sufficient water for its crews. Meals can be prepared by crews.

Battalion task force trains carry an additional 2 days' supply of water and rations for the task force. A further 3 days' supply of rations is stocked in the DISCOM, but water reserves held above task force will depend on availability; the greater the natural supply the less need be held in reserve. If water is not locally available forward of the brigade rear boundary it will require a higher transportation priority than rations.

Class II. There is little change in class II consumption. However, clothing variations, from tropical clothing to sweaters and sleep-

ing bags, must be planned for. Requirements for items such as neck scarves and canteens will be increased as well as those for hand tools, since tools tend to get lost in the sand.

Class III. There is a marked increase in oils and lubricants used in preventive maintenance, the actual quantities depending on operating conditions. Some types of desert terrain can lead to greatly increased fuel consumption per mile moved. The fluidity of desert operations requires fuel reserves to be readily available, so battalion task force trains should hold a minimum of 100 to 150 miles of fuel for every vehicle in the task force. Fuel reserves in the battalion task force should be equally divided between combat trains and field trains, when trains are echeloned. The fuel supply point in the brigade trains should also contain a minimum of 100 miles of fuel, adjusted by type in proportion to the usage rates of the brigade. In most cases, these rates will have to be developed by experience. Use of cans in certain circumstances should also be considered as they allow fuel to be spread more evenly among cargo vehicles since a loaded fuel tanker's cross country capability may be degraded in desert sand. Cans do, however, present handling and noise problems, particularly in the forward areas. Antifreeze requirements remain roughly the same as in temperate climates as antifreeze increases the boiling point of coolant and decreases wear on liquid-cooled engines.

Class IV. The requirement for class IV stores is roughly the same as in other theaters, but consumption of some items such as sandbags is greatly increased. Maximum use must be made of local materials. An engineer reconnaissance unit should be present in the theater from the initial buildup to establish what resources are available.

Class V. Due to excellent firing conditions, and need for extensive suppressive fires, ammunition consumption is high. It may be necessary to restrict firing of certain types of ammunition unless command approval is obtained, once they have reached predesignated levels. Battalion task force trains should contain 1 day's supply of ammunition and missiles for all vehicles in the task force, divided between combat and field trains when trains are echeloned.

Field artillery generally requires more ammunition per day than the quantity carried in the battery. Field artillery battalion trains require constant resupply even during the day, which can be met by using mobile ammunition supply points in the brigade trains or farther forward. Mobile ammunition points may be composed of a mixture of vehicles from the division supply and transportation battalion, organic vehicles of supported field artillery battalions, and elements of corps transportation cargo carrier companies (tracked). Resupply of mobile ammunition supply points should be by air if feasible. If ammunition supply rates are less than the required supply rates it may be necessary for higher field artillery commanders to restrict the number of rounds that may be expended on a fire mission.

Air defense artillery automatic weapons have high cyclic rates of fire, and carry very limited quantities of ammunition. Resupply vehicles for automatic ADA weapons platoons operating in forward areas may not be able to keep up with the platoon due to trafficability. Although it is probable that such platoons will be operating in direct support or under operational control of a battalion task force or company team, the task force commander must ensure that the platoon(s) has the required ammunition available. He should consider carrying spare ammunition on other task force vehicles.

If artificial obstacles are to be employed, considerable quantities of mines will be required as minefields must be long and deep to be effective. Since extensive minefields will be preplanned, relatively few antitank mines need be held in ammunition supply points forward of the division support area. When required, the quantities needed should be

moved by air as close to minefield locations as possible. Only mines necessary to replenish unit basic loads used for local defense need be stocked forward of the division.

Class VI. The demand for class VI supplies, especially liquids, is high. They are not, however, essential and if transportation is limited they are given a low priority, especially if refrigeration space is certain to be in short supply. Ration supplement sundries packs can be used. If space available for class VI supplies is limited, medical units should receive priority of issue.

Class VII. The demand for class VII supplies depends entirely on the intensity of the battle. The only variation that can be forecast is for refrigeration equipment, especially if it is necessary to move dead to the United States for burial.

Class VIII. Class VIII supplies may vary in type, but it is unlikely that the overall quantity will vary significantly from that required in temperate climates.

Class IX. There is a large increase in demand for class IX supplies due to environmental effects on equipment and the extra maintenance effort required. Small items with high usage rates should be held as far forward as team trains and may also be kept on fighting vehicles. Typical high consumption items are:

- Tires for wheel vehicles.
- Water pumps, gaskets, fan belts, water hoses and clamps.
- All parts for ignition systems.
- Wheel and sprocket nuts, wedge bolts.
- Spare caps for all liquid containers.
- Speedometers and cables (due to dead reckoning navigation these are critical items).
- Filter elements.

Mission essential lists of a unit depend on its equipment, but should be limited to only those items that would prevent such equipment from performing its task if they failed. Heavier and larger items can be carried by contact teams from the direct support maintenance company, which may be with the task force trains and in the company itself in the brigade trains. As demand varies from day to day, arrangements must be made for unexpected requirements to be moved to repair sites by air.

Forecasting. Due to extended lines of communication, consumption forecasts are very important in desert operations. Forecasts should be provided once a day and should include:

- A POL forecast for the next 24 hours.
- Status of the unit's basic ammunition loads.
- Equipment losses in the past 24 hours not previously reported.
- Status of reserve water and rations.
- Special supply shortages or maintenance problems, not previously reported.

Requests. Requests for class II supplies will be periodic, but those for class III, IV, V, VII, and IX will be requested as soon as required.

WATER

Water is vital, yet local supplies may be scarce or nonexistent in a desert combat zone. If water is plentiful, as it is in areas around Tripoli and Benghasi in Libya, water supply should not be a problem, provided that normal water supply procedures are followed. This paragraph deals with situations where local water is difficult to obtain.

The detail of reconnaissance for supply sites depends entirely on the equipment that is available to use them. Water purification trucks in a divisional engineer battalion, for example, are designed to be used from bodies of open water such as ponds, rivers, or paddy fields, and are not equipped to dig or work from wells. All units must maintain a continuous watch for possible sites such as oases, dry wells, dry water courses, open water (even marshes), or captured enemy dumps. These are reported to the next higher headquarters, giving the location and quantity and flow if possible. It is not the responsibility of these units to test the water for potability, which could be dangerous for untrained personnel. This task should be left to specialists.

When the report reaches the unit responsible for water, an engineer team including medical personnel is dispatched to reconnoiter the site. The team may consist of well-drillers, water distillers, and a water transport team. The team determines if the water can be made potable after tests for salinity, disease, presence of mineral salts and radio activity, and if the quantity available is sufficient to support a water point.

It is unlikely that a division water point can supply water throughout a 24-hour period as the equipment must shut down at intervals for periodic maintenance. Normally a water point is open only at specified times. When a water point is established, the division G4 disseminates its location and hours of operation to divisional units. Since distances between water points may be long, it may be desirable to augment the division with additional 5,000- and 2,500-gallon bulk petroleum tankers, processed to haul water.

Rationing. As previously discussed, men cannot be trained to require less water than their bodies need; although they can tolerate temporary restrictions. When circumstances arise that do not permit the desired quantities to be issued, there is no alternative but rationing. Men have existed in western deserts for considerable periods on 1-1/5 gallons of water per day for all purposes. Men can even exist on three-quarters of a gallon of water per day. However, efficiency will decrease after approximately 3 days. Men who are totally acclimatized can live on only 2 quarts of drinking water per day for short periods providing that little work is done in daylight and shade is available. Combat efficiency, however, will be seriously lowered.

Water should only be rationed for a limited period, the length of the period depending on the available quantity and work load. The ration should be adjusted according to duties of a unit. For example, if a unit is involved in heavy activity and is limited to a certain ration per soldier per day, a unit involved in light activity in the same area should only require two-thirds of that ration per person. A medical unit, on the other hand, will probably need double the ration allowed the unit involved in heavy activity for each patient. When it is necessary to ration water, medical advice on the quantities issued should be obtained.

If water is rationed, the amount per man is calculated, as are rations, on unit personnel status reports, plus a 1 percent increase for every time it is to be transferred from container to container to allow for losses.

Priorities for its use should be established. A suggested list is as follows:

- Vehicle and equipment cooling systems.
- Personnel (for drinking only).
- Working animals.
- Personnel (other uses).
  - Medical aid.
  - Cooking.
  - Cleaning of mess equipment.
  - Washing the human body.
  - Washing clothes.

If vehicle decontamination is necessary, it will take a high priority. Nonpotable water may be used for this task.

MAINTENANCE

In order to return equipment to battle as quickly as possible, repair of disabled equipment must be accomplished as close to the site of damage as possible. Evacuation should be limited to only that absolutely necessary.

Due to unit dispersion, organizational maintenance personnel and direct support contact teams will be spread thinly, so vehicle crews must be trained to make as many adjustments and repairs as they can. It is also necessary to employ the maximum number of combat oriented General Support Centers (COGS) as far forward as possible to assist in repairs beyond the capabilities of organizational maintenance personnel. FM 54-9 contains the operational concept for COGS, which provides integrated supply and maintenance support for groups of related materiel items and designated weapons or other systems.

General guidelines for desert repair are:

Repair only that necessary to make the equipment combat effective.

Recover and then evacuate to the nearest reasonably secure site, followed by on the spot repair.

A standing operating procedure (SOP) for recovery and repair must be established either before or immediately on arrival in the theater. The SOP should include:

- Guidelines for crew level recovery and expedient repair.
- Recovery by organizational maintenance.
- Recovery by direct support maintenance.
- Priorities for recovery by vehicle type.
- Limitations on field expedients, for example, the distance/time over which one tank is allowed to tow another considering the heat buildup in transmission in this environment.
- Recovery of classified equipment such as crypto.
- Security and guides for recovery teams.

The recovery plan of an operation should include locations of collection points for equipment that cannot be repaired farther forward. These points must be sited where they can be reached by heavy equipment transporters, which may involve a longer tow by a VTR than would be normal in a European environment. The collection point should cover a large area to allow for dispersion of its extremely vulnerable targets. A direct support maintenance contact team ought to be located at the collection point to cannibalize badly damaged equipment before evacuation. When considering recovery in the desert, special attention must be paid to ground anchoring equipment as natural anchoring material is scarce. Recovery of disabled aircraft is discussed in FM 55-143, *Aerial Recovery of US Army and Air Force Aircraft.*

PERSONNEL SUPPORT

The peculiarities of the desert environment have very little effect on personnel support procedures. Staffs, however, must be prepared to manage personnel actions and recordskeeping manually until the emplacement of automatic data processing equipment, so units likely to take part in desert operations should maintain a manual capability.

Mail is important to the soldier fighting in the desert as it will assist in defeating a sense of isolation caused by the environment and the necessary dispersion of units. It is especially important in the first few weeks to counter the effect of the shock of entering totally new terrain. Transportation of mail should be given a high priority on arrival in the theater of operations.

HEALTH SERVICES

Organization. Medical unit requirements for desert operations are essentially the same as for temperate climates; although each brigade should have an environmental sanitation team attached. When planning for medical support, the following factors should be considered:

First, increased dispersion and large areas over which battles are fought increases vehicle evacuation time. This problem can be further complicated if the enemy does not recognize the protection of the Red Cross, thereby inhibiting air evacuation within range of enemy air defense weapons.

Second, the comparatively long distance between units may limit the availability of medical aid men to adequately support combat troops. Reinforcements may be required from the division medical battalion or from supporting corps-level medical units.

Third, incidence of illness from heat injuries and disease is higher than in temperate climate. Fevers, diarrhea, and vomiting, for example, cause loss of water and salt, which can culminate in heat illnesses. Cold weather injuries can also occur during a desert winter.

Fourth, mobility required of maneuver units will be inhibited if movement of any part of these units, including trains, is restricted by having to hold a number of casualties. Wounded and sick must be evacuated immediately.

Fifth, in order to properly treat patients, all medical treatment facilities should be provided additional supplies of water and salt tablets. Medical personnel at all levels must assist tactical commanders in preventing or reducing heat casualties within their units.

Divisional medical units should be augmented with extra field ambulances from corps units. In an emergency, empty cargo trucks moving to the rear can be used for medical evacuation.

Field ambulances may either drive back to the clearing station or, if air ambulances flying NOE can get forward, they may

rendezvous with aircraft close behind the battalion. Air ambulances will then take patients direct to appropriate supporting corps-level treatment facility.

The effects of nuclear weapons can be expected to be greater in desert terrain. Introduction of these weapons by the enemy will greatly increase casualities and severly strain available medical resources. The same effects can be expected if the enemy introduces chemical weapons against unprepared troops.

NAVAL AND AIR FORCE ASSISTANCE

Naval. During the initial stages of an operation it may be necessary to request logistic support from the US Navy. Ships, with the exception of a few special types, are neither designed nor equipped to give logistic support to ground forces. Such support, however, is possible to a limited degree, provided that it has been planned for. A cruiser, for example, may have more than 20,000 gallons of water per day available beyond the requirements of the crew. Limited supplies of items such as bread may be available, as may facilities for surgical and medical assistance.

Air Force. The military air command (MAC) in support of the force provides tactical airlift. Air force assistance must be coordinated with MAC to deliver personnel, supplies, and equipment forward to brigades and farther forward when necessary. Delivery is made by the most suitable means available, airlanding, extraction, or airdrop. MAC also makes aircraft available for rearward movement of wounded persons or prisoners of war.

COMBAT SERVICE SUPPORT

Graves Registration. Due to unit dispersal and rapid maneuvering over large distances, separate gravesites may have to be utilized in extreme situations. Each unit operating in this environment must develop a stringent and detailed SOP to indicate conditions under which separate gravesites will be used and recovery of remains at earliest opportunity.

Property Disposal. Depending on the anticipated length of the operation, the force commander can determine if property disposal activities will need to be established.

Fumigation, Bath, and Laundry Services. These activities may not be possible in the early stages of an operation or not at all in forward areas. More effort than ordinarily required will be necessary to provide these services in a desert environment.

DESERTS OF THE WORLD [1]

Name [2]	Area (square miles) [3]
North and Central America	
Black Rock Desert, northwest Nevada	600
Colorado Desert, California/Mexico	3,000
Columbia Plateau, Washington/Oregon/Idaho	—[4]
Chihuahua Desert, Mexico	—[4]
Grand Desert, Sonora, Mexico	2,500
Great Basin, north central Nevada	—[4]
Great Salt Lake Desert, northwest Utah (ajoins the Great Basin)	4,000
High Desert, central Oregon	3,000
Mapimi Desert, northern Mexico	—[4]
Mexican Plateau	—[4]
Mohave Desert, Southern California	13,500
Painted Desert, northeast Arizona	—[4]
Smoke Creek Desert, northwest Nevada	300
Sonoran Desert, Gulf of California, Mexico	—[4]
Vizcaino Desert, Baja California, Mexico	6,000
Wyoming Basin Desert	—[4]
South America and Pacific	
Atacama, northern Chile	140,000
Patagonian Desert	260,000
Phoenix Islands, South Pacific (South of Hawaiian Islands; approx 3° S, 171° W)	—[4]
Sechura Desert, northeast Peru	10,000
Tumbe Desert, north Peru	—[4]
Western Argentina Desert	—[4]
Africa	
Kalahari Desert, Botswana	200,000
Karroo, South Africa	—[4]

Libyan Desert (part of Sahara)[5]	650,000
Namib Desert, Southwest Africa	—[4]
Nubian Desert, northeast Sudan (part of Sahara)	100,000
Sahara Desert, northern Africa	3,000,000
Western Desert, Somaliland	—[4]
The Middle East	
Arabian Desert, Arabia	500,000
Dasht-e-Kavir, north Central Iran[6]	18,000
Dasht-e-Lut, eastern Iran	20,000
Dasht-e-Naomid, Iran-Afghanistan border	—[4]
Jafura, southwest of Persian Gulf (part of Arabian Desert)	—[4]
Kerman Desert, south Iran	—[4]
Nefud, north and central Saudi-Arabia (part of Arabian Desert)	50,000
Negev, Israel	—[4]
Rub-al-Khali, southeast Saudi-Arabia (part of Arabian Desert)	250,000
Sinai Desert, east of Suez Canal	—[4]
Syrian Desert, Northern Arabia Peninsula (part of Arabian Desert)	125,000
Asia and USSR	
Afghanistan Registan	—[4]
A-la Shan, China (part of Gobi)	—[4]
Dasht-e-Margo, Afghanistan	15,300
Dasht-e-Naomid, Afghanistan-Iran border	
Dxosotin Elesun, Soviet Central Asia	—[4]
Great Barsuk, Kazakhstan SSR	
Gobi Desert, Mongolia	300,000
Helmand, South Afghanistan (both sides of Helmand River)	—[4]
Kara-Kum, Turkmen SSR	105,000
Kyzl-Kum, Uzbek SSR	90,000
Ordos Desert, China (east of A-la Shan, part of Gobi)	—[4]

Peski Muyan-Kun, USSR (44° N, 71° G, East of Kara Tau)	17,000
Peski Sary-Inhik-Otrau USSR (south of Lake Balkhash)	—[4]
Priaral Desert (part of Great Barsuk)	—[4]
Rajputana Desert, Indian—Pakistan border (between Sind and the Punjab)	—[4]
Takla Makan, South Sinkiang, China	125,000
Tarim Basin Zextension of Gobi) (contains Takla Makan)	—[4]
Tau Kum (part of Peski Sary-Ishik-Otrau)	—[4]
Thar Desert, northwest India/Pakistan	77,000
Turfan Depression, Sinkiang, China (part of Gobi)	—[4]

Australia

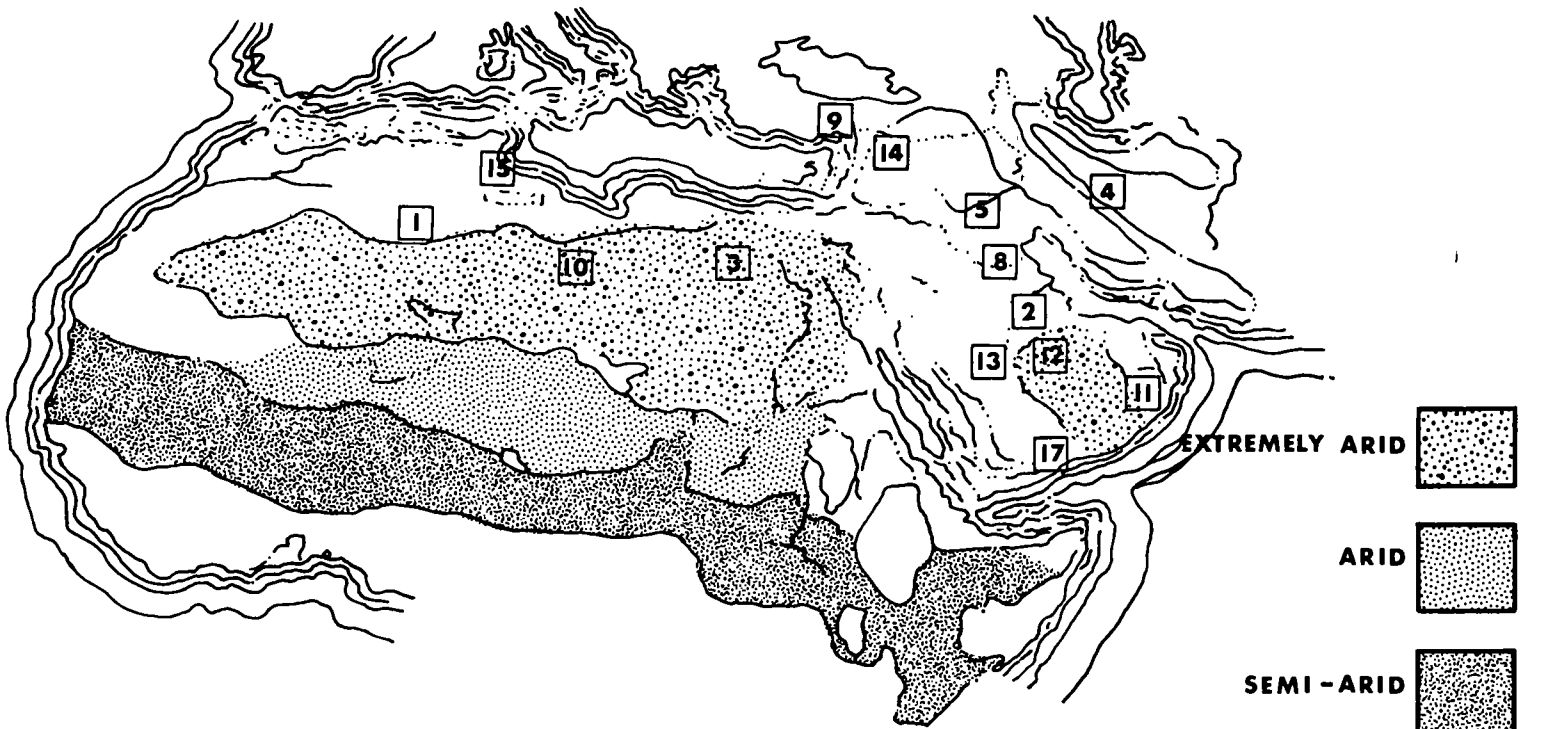
Australian Desert, which includes:

Simpson Desert, Central Australia	120,000
Gibson Desert, Western Australia	85,000
Great Sandy Desert, Northwest Australia	160,000
Great Victoria Desert, Southwest Australia	125,000

Notes. 1. The areas listed vary from total barreness to semiarid.
2. For detailed descriptions study the relevant volume of the DA Pamphlet 550 series.
3. Approximate. It is difficult to define the boundaries of a desert.
4. Reliable estimate of area not available.
5. Live minefields from World War II still exist in certain parts.
6. Also called the Khorasan Desert.

DESERT COUNTRIES OF THE MIDDLE EAST AND DESERTS OF THE WORLD

This appendix provides brief descriptions of desert countries of the Middle East and a listing of the deserts of the world. Updated detailed information can be obtained from a terrain analysis from the Defense Intelligence Agency and the relevant volume of the DA Pamphlet 550 series. A certain amount of terrain intelligence is also available in World Road Maps Series 1304W—Middle East—scale 1:1,000.000



COUNTRIES OF THE MIDDLE EAST

SERIAL	COUNTRY	AREA (sq miles)	POPULATION (Millions)	LANGUAGE(S)	ADJACENT COUNTRIES	DA PAM 550 No	REMARKS
1.	Algeria	919,591	16.8	Arabic, Berber, French also spoken	Morocco, Spanish Sahara, Mauritania, Mali, Niger, Libya, Tunisia.	44	Divided into Northern Algeria and The Sahara. Ninety-four percent of population lies in former area, approximately 12 percent of the total area of the country. The Sahara area, 3,000,000 square miles, is one of the hottest and most barren regions on earth. The Sahara has a classic desert climate.
2.	Bahrein	231	0.3	Arabic, some English	Saudi Arabia, Qatar (separated from both by Gulf of Bahrein).	92	Small island in Persian Gulf, averages 8 inches of rain a year. Average day temperatures vary from 68°F in January 100°F in August. Has reasonable water supply from underground springs.
3.	Egypt (United Arab Republic (UAR)	386,660	37.5	Arabic	Libya, Sudan, Israel.	43	Divided into the Western and Eastern Deserts (separated by the Nile River and the Sinai). The Western Desert is extremely arid with very limited trafficability except near the coast.
4.	Iran	636,293	32.9	Persian, tribal dialects	Iraq, Turkey, USSR, Afghanistan, Pakistan.	68	The country has a mountainous rim on all sides and a central plateau which has no outside drainage. Lake Rezaiych, on northwest of plateau, is 2,700 square miles but less than 70 feet deep and too salty for fish. Wide climatic variations with annual rainfall varying from 50 inches in some mountains to less than 2 inches in the central plateau desert, where temperatures change from 132°F in summer to below freezing in winter.
5.	Iraq	167,924	11.1	Arabic, Some minority languages	Syria, Jordan, Saudi, Arabia, Kuwait, Iran, Turkey.	31	Four main zones: the uplands between the upper Tigris and Euphrates rivers, the highlands in the north, the alluvial plain between the rivers, and the desert in the south and southwest. This last area consists of a wide stony plain with generally good trafficability. Agriculture throughout the country requires extensive irrigation.
6.	Israel	7,992	3.4	Hebrew, Arabic, Some Yiddish and English	Egypt (UAR), Jordan, Syria, Lebanon.	25	Three general areas: the coastal plain, the hill region, and the Jordan rift valley. The coastal plain is fertile and humid; the latter areas have limited rainfall and average humidity. The south part of the hill region constitutes The Negev, which has extremely limited rainfall. The acquisition, storage, control, and transportation of water is one of the nation's greatest problems.

SERIAL	COUNTRY	AREA (sq miles)	POPULATION (Millions)	LANGUAGE(S)	ADJACENT COUNTRIES	DA PAM 550 No	REMARKS
7.	Jordan	37,737	2.7	Arabic, Tribal dialects	Israel, Syria, Iraq, Saudi Arabia.	34	The depression of the Jordan River valley divides the country into two areas, the West Bank and the East Bank. Most of the East Bank, which forms the majority of the nation's area, is desert, with temperatures varying from over 100°F in the summer day to snow in the winter. There are extensive lava beds in the north near the Syrian border.
8.	Kuwait	6,880	1.1	Arabic, Some English	Iraq, Saudi Arabia	92	Undulating gravelly desert with a few low ridges, almost totally waterless except for a short time after rains. Most water for population acquired by distillation of sea water. Climate not quite as severe as in other parts of the Gulf as intense humidity does not last as long. Sand and dust storms frequent in summer.
9.	Lebanon	4,015	2.9	Arabic, French, and English often spoken	Syria, Israel.	24	This country is unusual in the Middle East in that it has very little semiarid area (the Biqa Valley only) and no desert. Daylight temperature variations both winter and summer, are between 40° and 50°F depending on locality.
10.	Libya	679,359	2.3	Arabic	Egypt (UAR) Sudan, Chad, Niger, Algeria, Tunisia.	85	Three traditional regions of Tripolitania, Cyrenaica, and The Fezzan. Only 5 percent of total land area (two enclaves on coast) is economically useful. Majority of country is desert with rocky plateau areas and few oases. Desert temperatures vary between 90° and 110°F in summer dropping to night temperatures of 40°F in winter. Water is extremely limited.
11.	Oman	85,000	0.8	Arabic	UAE, Saudi, Arabia, Yemen (Aden).	92	Considerably varied terrain. The northeast and Dhafar coasts are fertile but much of the remainder of the country is arid and barren. Many mountain ranges dropping towards the Empty Quarter. Summer climate is one of the hottest in the world, with high humidity.
12	Qatar	4,000	0.1	Arabic	Saudi Arabia.	92	A peninsula in the Persian Gulf. Arid, stony, sandy, and barren. Temperatures in the summer reach 120°F with high humidity.

SERIAL	COUNTRY	AREA (sq miles)	POPULATION (Millions)	LANGUAGE(S)	ADJACENT COUNTRIES	DA PAM 550 No	REMARKS
13.	Saudi Arabia	830,0000	9	Arabic	Iraq, Jordan, Yemen, (San'a'), Yemen (Aden), Oman, UAE, Qatar, Kuwait.	51	Occupies nearly all of the Arabian Peninsula. The country as a whole dips gently from west to east, from the mountains near the Red Sea to the Persian Gulf. The south is dominated by the total desert of the Empty Quarter (250,000 squares miles). There is a smaller desert in the north (22,000 square miles) and the two are connected by a third which is approximately 900 miles long but only 30 miles wide. There are numerous salt marshes near the Gulf. Very limited average rainfall. Temperatures very high in summer but cool in winter.
14.	Syria	71,516	7.3	Arabic	Lebanon, Israel, Turkey, Iraq, Jordan.	47	The four natural regions are the coastal plain, the eastern plateau region, the Hamad (desert), and the fertile area around the Euphrates. But for the river the latter would also be an arid area. Great contrasts in climate between the humid coastal plain and the Hamad; the eastern plateau region which covers three-quarters of the country averages less than 8 inches of rain a year.
15.	Tunisia	63,170	5.7	Arabic, French also understood	Algeria, Libya.	89	Four natural regions of the Tell, The Stepps, The Sahil, and The South. The Tell and Sahil regions are relatively wet and fertile; The Stepps are semiarid and The South is desert. Underground water frequent in South but may be 1,000 feet down and very saline.
16.	United Arab Emirates (UAE)	32,000	0.2	Arabic, some Persian	Qatar, Saudi Arabia, Oman.	92	A loose federation of the sheikdoms at the southern end of the Persian Gulf, with each one remaining responsible for its own internal affairs. Nearly total desert except in northeast corner, which is backed by mountains rising to 8,000 feet. Very hot, and very limited rainfall.
17.	Yemen (Aden)	111,075	1.7	Arabic	Yemen (San'a'), Saudi Arabia, Oman.	92	Situated at the extreme south of the Arabian plateau. There is a flat sandy coastal area 5-10 miles wide. The remainder of the country is mountainous ranging from 8,000 feet in the west gradually tapering off in the east. The Wadi Hadramaut, in the east, is a wide valley running parallel to the coast. Overall average rainfall 3 inches but rainstorms cause immediate floods in the wadis, making them very dangerous. Temperatures are high.
18.	Yemen (Sinai)	75,290	6.7	Arabic	Saudi Arabia, Yemen (Aden).	92	Very undeveloped country. The coastal sand strip, approximately 40 miles wide, is semidesert, but with high humidity. Behind it lies a tilted plateau with hill ranges rising to 4,000 feet and limited trafficability. Climate in hills very reasonable with many rivers; they do not, however, manage to cross the coastal sand strip due to high evaporation and absorption.

EMPLOYMENT OF ARMY AIRCRAFT IN DESERT OPERATIONS

Army aircraft may be employed as in temperate climates within the limits imposed by enemy long range observation and defense means; although some degradation in performance must be expected due to environmental effects.

Aircraft operating in the desert require more maintenance per hour flown than in temperate climates. Pilots require a very high standard of tactical training. Nap-of-the-earth (NOE) flying is essential. When possible, flying should be done in shaded areas and over terrain that is well-compacted to reduce dust. Scouts and attack helicopters should fly between sand dunes to avoid being seen by enemy radar. Their mobility however, may be degraded due to general lack of concealment against enemy air defenses.

Attack helicopters will not be able to loiter in holding areas so scouts work in pairs. One returns to the holding area to guide an attack helicopter platoon(s) forward while the other maintains contact.

CONCEALMENT

Helicopters with rigid rotor blades are extremely difficult to conceal. Nets weigh a minimum of 65 pounds, and it may not be possible for an aircraft to carry them on a tactical mission as its payload is already restricted by air density. Therefore, concealment aids such as nets must be pre-positioned at any landing areas in constant use. Camouflage techniques are described in appendix F.

As soon as rotors start to move, sand and dirt will rise in clouds that are easily visible for thousands of meters, and can attract enemy attention. In order to minimize this problem:

Landing sites should be chosen so as to minimize loose sand and grit.

Aircraft hovering close to the ground must be kept to an absolute minimum, especially in daylight.

Running take offs and landings should always be used, as they reduce the updraft and help overcome the problem of reduced lift.

Landing areas should be treated with oil or chemicals, provided that concealment is not significantly degraded.

Aircraft should be parked in positions that will not require taxiing to a takeoff point (unless ground handling equipment is available).

Aircraft parking areas should not be too close to ground units, especially units such as trains, which cannot move quickly, as enemy attention will be drawn to these areas. To avoid drawing attention to such units, pilots may use a false landing technique, landing at a variety of sites, only one of which is relevant to the mission. Once moving, aircraft must fly NOE over areas where soil surface is bound down by rocks, and use any available cloud cover to reduce the possibility of reflection. When the aircraft has arrived at its destination it may be preferable to land behind cover and shut down rather than hover, even if the aircraft itself is concealed.

LOW LEVEL NAVIGATION AND CONTROL

Terrain flying and desert navigation requires continuous concentration. Desert navigation is difficult, particularly in areas with inaccurate maps or no significant terrain for resection. The following aids can be used:

Up-to-date sketches or air photographs showing recognizable features such as differences in color and texture of terrain surface, general pattern of sand dunes, semipermanent wreckage such as burned-out vehicles, or marked minefields. Grid lines should be placed on the drawing or photograph.

FM beacons or homers can be used to find a forward area rearming and refueling point, a command post, or other installations. The equipment should be placed some distance from the point it is marking and a compass bearing should be used for approach to ensure that the homer will not lead enemy into the area.

Ground smoke or firing tracer on a fixed azimuth can be used to allow assault aircraft to maintain direction.

A large number of aircraft departing or arriving at the same place at the same time will cause an easily visible sand updraft obscuring the entire area. This updraft will require careful selection of sand-free areas (which can often be found) for approaches and landing zones, strict timing between flights to allow the sand to subside, and possible separate sites for different lifts.

Weather in desert regions can be extremely unpredictable. Sandstorms, accompanied by constantly fluctuating wind speeds, may reduce visibility from in excess of 50 kilometers to zero in less than 5 minutes. Pilots must be carefully briefed on prevailing weather conditions before takeoff. Warning of any expected variations in conditions must be transmitted immediately to all airborne aircraft.

THE PERFORMANCE OF HELICOPTERS IN HEAT

Aviation personnel must refer to the appropriate aircraft technical manuals to determine aircraft limitations and capabilities in the desert environment. Significant effects on the payload capabilities should be anticipated.

Commanders must develop realistic aircraft utilization procedures based on the environmental effect data provided by aviation staff personnel to obtain the fullest benefit from aviation assets.

TECHNIQUES FOR OPERATING EQUIPMENT IN THE DESERT

The desert environment and its effects on equipment were described in chapter 2. This appendix describes techniques which, if used when operating equipment in the desert, can save both equipment and lives.

DRIVING

Sand. Sandy desert may be relatively flat or broken up by windblown dunes. When driving in sand, the following techniques should be applied.

The best time to drive on sand is at night or early morning when the sand is damp and traction is better.

Drivers of track vehicles must be wary of a lack of steering response, which indicates sand is building up between the rear sprockets and treads. If allowed to continue, sand buildup will force the tread off. "Shaking" the vehicle with the steering or backing up will throw off the sand.

Wheel vehicles may gain some traction by reducing tire air pressure. However, prolonged driving on partially deflated tires will overheat the tires and break down the side walls.

Vehicle loads must be evenly distributed. Rear wheel drive should be used where possible to avoid digging in front wheels.

Drivers must switch to all wheel drive or change gears before a vehicle bogs down. Once bogged down, changes will do no good.

Drivers should select a gear prior to entering sand that will allow the vehicle to maintain as much torque as possible without causing the wheels to spin and to minimize changing gears.

Some sand areas will be covered by a surface crust. This is caused by chemicals in the ground cementing sand particles together. In many cases it will be possible to drive on top of this crust and minimize dust signature and the chance of bogging down. When driving on a crust, several additional techniques must be applied:

Vehicles should follow one behind the other, if it is possible to do so without breaking through the crust.

Often vehicles must maintain a minimum speed, determined from experience, below which they will break through the crust.

Sharp turns and abrupt starts or stops will cause a vehicle to break through the crust.

Patches of a different shade must be reconnoitered to ensure they are not softer than the surrounding crust.

Crossing dunes requires careful reconnaissance. Normally, the upwind side of the dune will be covered with a crust and have a fairly gradual slope. The downwind side will be steeper and have no crust. Prior to crossing a dune, the driver should climb it on foot checking crust thickness, the angle at the crest to ensure the vehicle will not become bellyed at the top, and the degree of slope and softness of the downwind side. If he is satisfied his vehicle can climb the dune, he

should drive the vehicle straight up it at best speed, crest it, and maintain a controlled descent on the other side.

Hillock Areas. The wind may have built up sand around small shrubs forming little hills. Wheel vehicles should not attempt to move through areas where this has occurred without engineer assistance.

Thorn Areas. Cactus or thorn bushes will cause frequent tire punctures. When operating in areas covered with this type of vegetation it will be necessary to increase the number of tires carried in a unit's PLL.

Rock. Rock and boulder-strewn areas, including lava beds, may extend for many miles. Desert rocks, eroded and sharp-edged, vary in size, and are so numerous that it is almost impossible to avoid any but the largest. The subsequent harsh jolting tires individuals and causes extreme wear on tracks, wheels, springs, and shock abosorbers. Vehicles can follow one another in this type of terrain and it may be feasible to reconnoiter and mark a route. Drivers should achieve a "rolling" effect as they cross large rocks, by braking as vehicle wheels ride over a rock so the axle settles relatively gently on the far side.

Marsh. Salt marshes (called subkhah) are normally impassable, the worst type being those with a dry crust of silt on top. Marsh mud used on desert sand will, however, produce an excellent temporary road. Many desert areas have salt marshes either in the center of a drainage basin or near the sea coast. Old trails or paths may cross the marsh, visible during the dry season but not in the wet season. In the wet season trails are indicated by standing water, due to the crust being too hard or too thick for it to penetrate. However, such routes should not be tried by load-carrying vehicles without prior reconnaissance and marking.

RECOVERY

Track vehicle recovery methods are the same in the desert as in temperate climates. Techniques described below will assist wheel vehicle recovery operations in sand crust or salt marsh.

To assist in recovery, wheel vehicles should carry the following items:

- Steel or aluminum channels, at least for the driving wheels. These are pierced to reduce weight and ribbed for strength. Pierced steel planking (PSP) or galvanized iron may be used as a substitute.
- Sand mats made of canvas, preferably with lateral strips of metal to give strength and increase the traction of the wheels.
- Spurs (dual-wheel vehicles only). Circular or inverted T section.
- Jacks and jack blocks.
- Tow rope(s).
- Shovels.

Once a vehicle becomes stuck, the ground under the vehicle is excavated in a gradual slope towards the direction of recovery to a point where no part of the underside is touching the ground. Channels or spurs and mats are laid under or against the wheels facing the direction of recovery. Tire pressure may be reduced to increase traction, but this

will lower the vehicle. It may be necessary to lift the wheels with a jack if the vehicle is resting on its frame or axles.

When the vehicle begins to move, any faltering will cause it to sink again. Once out, the driver must maintain speed until the vehicle has reached the nearest hard area. At this point the tires are re-inflated, the vehicle inspected for damage, and recovery equipment collected.

Vehicles equipped with winches can winch themselves out using ground anchors. The ground anchor may consist of a tarpaulin full of sand placed in a hole and the winch cable attached to it, or it may be 1 or preferably 2 spare wheels well dug in.

A rubberized fabric balloon may be used on light vehicles to lift them free of broken crust. The balloon is placed under the vehicle and blown up with the vehicle exhaust.

If a lone vehicle breaks or bogs down in desert the crew *must stay with it.* A vehicle is much easier to find than a lone man.

EQUIPMENT

Equipment directly affected by heat, such as aircraft and radios, is equally affected by all deserts. Power trains and suspension systems however, are affected in proportion to the trafficability and soil texture. Much damage can be avoided by careful driving and by careful observation by vehicle commanders.

Tank Combat M60A1. Constant use on rocky plateau desert will reduce the life of T97 and T142 track to approximately 8 weeks; although the T142 track is superior if track pads are removed, since they are extremely difficult to keep tight. Track tension must be correct. Suspension units will require frequent replacement of torsion bars and suspension arms. Terrain will also cause damage to internal parts of idler and suspension arms. Cases have occurred when road wheel support arms sheared from the hull, particularly with front roadwheels. Direct support maintenance units must be provided with equipment capable of tapping and removing the sheared bolts.

In areas where vegetation exists, engine overheating caused by dust and dead scrub clogging engine oil coolers and cylinder cooling fins often occurs. This leads to oil breakdown and engine failure. Some of this overheating may be prevented by placing small-mesh wire screening over the top grille doors, but it may still be necessary to remove packs at approximately 10-day intervals to clean the engine cooling fins. The wire screening should be periodically checked, removed, and cleaned.

Transmission systems are also liable to overheat. Strain on transmissions, particularly if operating in hot barren mountains, can lead to band failure. It is necessary for maintenance personnel to inspect and adjust bands often.

The ambient heat will limit the ability of air-cooled generators to keep within operating temperatures, leading to early failure, so increased stockage of generators is necessary.

Personnel Carrier M113A1. The M113A1 presents few problems in desert conditions. Transmissions may overheat and bands must be kept correctly adjusted. The solid-state voltage regulator is more liable to overheat than the older mechanical type, leading to a higher failure rate.

Wheel Vehicles. On rocky deserts the M54 5-ton truck is prone to air hydraulic cylinder failure and power steering seal leaks. All vehicles of the 1/4- to 5-ton range are prone to clutch failure caused by drivers "riding" the clutch pedal. Tire consumption is

very high, so all vehicles must carry 1, or preferably 2 spare tires and the unit PLL of tires must be increased considerably. Approximately 1 vehicle in every 3 should carry jump cables to provide for battery failure.

Radios. A radio, regardless of type, must be kept *cool* and *clean*. It must be in shade whenever possible and should be located in a ventilated area (or even an air-conditioned van). If water is available, wrap it in a damp towel, ensuring that the air vents are not blocked. Additional radios should be available in vital communications centers such as tactical operations centers to allow immediate replacement if the set in use shows signs of overheating. A radio not in use should be kept covered to keep out sand and dust and the "badge" of an operator should be the paint brush he uses to clean dust from his equipment.

Antennas must be cut or adjusted to length of the operating frequency; this is *essential*. Directional antennas must be faced exactly in the required direction; approximate azimuth produced by guess work will not do. A basic whip antenna relies on the capacitor effect between itself and the ground for efficient propagation. The electrical ground may be very poor and the antenna performance alone may be degraded by as much as one-third if the surface soil lacks moisture, normally the case in the desert. If a ground mounted antenna is not fitted with a counterpoise, the ground around it should be dampened, using any fluid available. Vehicle-mounted antennas are more efficient if the mass of the vehicle is forward of the antennas and is oriented towards the distant station.

Desert tactics require dispersion, yet the environment is likely to degrade the transmission range of radios, particularly VHF (FM) fitted with secure equipment. This degradation is most likely to occur in the hottest part of the day, approximately 1200 to 1700 hours.

If stations start to lose contact, especially if the hotter part of the day is approaching, alternative communication plans must be ready. Alternatives that may be considered are:

- Changing secure links to insecure, which usually increases ranges of sets after secure equipment has been removed.
- Relay stations:
  - An airborne relay station (the aircraft must remain at least 4,000 meters behind the line of contact).
  - Any unemployed vehicle with radio may also be deployed as a relay between stations.
- Alternative radio links such as VHF multichannel telephone at higher levels, or HF (SSB) voice.
- Use of wire. Normally wire will not be used as operations will be fluid, but it may be of some value in some static defensive situations.
- Messengers. A unit such as all or part of the task force scout platoon may be used for messenger service. Although it is undesirable to use such a unit in this manner, it may be necessary, to maintain communications.

EFFECTS OF ENVIRONMENT ON NUCLEAR, BIOLOGICAL, AND CHEMICAL WEAPONS

The primary purpose of using nuclear, biological, and chemical (NBC) weapons is the same as for any other weapons—to produce casualties, destroy or disable equipment, and generally distrupt operations. Chemical and biological agents and nuclear weapons may be employed separately or in coordination, and when used, normally supplement conventional weapons. Tactical employment of nuclear, chemical, and biological weapons is described in detail in FM 101-5-1 and How-to-Fight manuals appropriate to each level of command. This appendix describes the effects of the desert environment on these weapons.

WEATHER AND TERRAIN

Both desert weather and terrain affect the behavior of nuclear, chemical, and biological weapons, and to some extent, influence their tactical employment.

Weather.

Temperature. High temperatures in the middle of the day means a decrease in air density, so nuclear blast waves move faster. High temperatures also mean that some chemical agents that come in contact with the skin are more effective due to perspiration. Biological agents are likely to be relatively ineffective except within a small radius of the point of impact.

Air stability. The effectiveness of nuclear, chemical, and biological attacks will be directly proportionate to air stability. Air stability is a result of temperature variations at various levels of the air. The span of desert day and night temperatures causes extremes of air stability from the very stable at night caused by temperature inversion (the air at ground level is cooler than that above ground) to the highly unstable in the afternoon caused by varying convection currents and consequent turbulence. Night therefore, may be best for a chemical, biological, or low airburst or ground burst nuclear attack with far-reaching downwind drift; while conditions in the afternoon can cause quick and irregular dissipation of the chemical or radio-active cloud, leading to a more ineffective attack and possibly putting friendly troops in danger.

Winds. High winds, common in certain desert seasons, affect the behavior of chemical agents and may dissipate fallout and chemical clouds.

Terrain. Under stable conditions (no wind or air instability) movement of chemical and nuclear effects is even and steady in all directions due to the relative flatness of most desert terrain and lack of vegetation. Chemical contamination and nuclear induced radiation at the point of burst varies, depending on the softness of the soil. The soil itself below the surface crust is normally unstable, so the blast and suction effect of nuclear weapons will cause considerable dust clouds, which will hang in upper air levels for many hours.

NUCLEAR WEAPONS IN THE DESERT

Blast. Blast, even from an air burst, raises considerable quantities of sand and dirt, which inhibits observation and maneuver for a long period. Light air density,

especially during the hottest parts of the day, causes a drop in static overpressure of the shock front but it expands more rapidly than in cooler climates; this increases the immediate danger to aircraft such as helicopters. Radius of damage from ground zero (GZ) is normally less than in temperate climates and dug-in personnel and materiel are safer. Trafficability in the immediate area of a strike is degraded especially for wheel vehicles, as the sand crust will have been destroyed. Sand may, however, fuze into semiglass, especially if it contains large quantities of silica.

Nuclear Radiation. Since immediate nuclear radiation is a function of the yield of the weapon, it varies little from that of temperate climate. Residual radiation is considerable in the case of low airburst or ground burst weapons. Residual radiation is affected by the time of day and may be evenly distributed around the point of burst (night, no wind), drift downwind for many miles (night, steady wind), or be totally irregular in quantity or direction (late afternoon). Induced radiation will be prevalent in alkali soils, sand ground, and salt marshes due to the quantities of sodium salts, silicon, and magnesium they contain. Constant CBR reconnaissance, especially of water sources, is vital once the weapons are employed.

Thermal Radiation. The effective range of heat and light increases in areas where there is no terrain masking, thus increasing the danger of troops receiving severe burns. The quantity of sand and dust sucked up by the explosion may, however, decrease the intensity of thermal radiation as it is adversely affected by opaque substances. Light causes dazzle out to 50 kilometers at night; so this must be considered when determining radius of warning, especially for aircraft and for units using night vision equipment. If there is any vegetation in the area of operation it can be expected to catch fire out to a distance beyond the radius of damage for protected troops.

BIOLOGICAL WEAPONS IN THE DESERT

Although the United States has renounced the use of biological agents, an enemy may use them. Biological agents are living micro-organisms that multiply in the body to cause disease. High ambient temperatures may destroy a considerable quantity of such germs before they have a chance to enter a human. There is usually a delay of days or weeks between entry and outbreak of disease; so these weapons would probably be used strategically rather than tactically. Water sources must be tested at frequent intervals and guarded at all times to limit enemy opportunities for water pollution with biological agents.

CHEMICAL WEAPONS IN THE DESERT

High temperatures of the desert day increase incapacitating effects of liquid agents, which rely on skin penetration, in a comparatively small area around the target. Air instability, however, is most likely to cause quick, vertical, and irregular dissipation of an agent, which leaves the target area relatively free of contamination comparatively quickly. Chemical weapons used during the heat of the day are normally persistent nerve or blister gases with the aim of catching personnel who have removed their protective clothing prematurely. High temperatures also cause liquid agents to evaporate more quickly, thus lessening the duration of hazard. If the liquid is allowed to soak into soft porous soil such as loose sand, evaporation does not occur as quickly.

Strong winds also increase the evapora-

tion rate of liquid agents and cause chemical clouds to act similarly to radioactive fallout, although over shorter distances.

TACTICS

Nuclear. Nuclear weapons are usually considered as weapons of destruction, with fallout an undesirable side effect that damages noncombatants and agricultural terrain. Their ability to contaminate, however, could have a considerable bearing on desert tactics. The high trafficability of track vehicles in desert produces apparently endless numbers of avenues of approach in the defense and equally makes it difficult to find a fixed point around which mobile forces can maneuver. In these conditions a surface or subsurface burst can produce sufficient induced and residual radiation to form an impassable obstacle for a given period of time. A series of such explosions could be used to canalize an enemy and force him to concentrate, thus providing a profitable target for a weapon used in the destructive role. Equally, a force that is attacking, or is so close to the enemy that nuclear weapons cannot be used directly on the enemy, may be able to cut him off from reinforcement by use of one or more weapons to his rear. Contamination, therefore, might become an asset if civilian lives or productive land are not involved. Their possible use by an enemy in the same manner means that every effort must be made to find and destroy nuclear delivery means.

Chemical. Chemical weapons are exclusively contamination agents. Due to air instability, a far heavier expenditure of ammunition will be required for a daylight attack than if the target was engaged at night. Periods of air stability and instability are relatively predictable, however; so it would be profitable to lay down a concentration of nonpersistent agents during the night, followed by an attack at dawn after a suitable time has elapsed to allow the agents to dissipate. Assaulting troops must be fully protected when supported by a chemical attack in desert as the evaporation time of liquid agents from highly porous soils is difficult to predict.

A second application of chemical weapons in desert, which does not require surprise or expenditure of large quantities of ammunition, is harassment by occasional use of a minimum quantity of munitions at irregular intervals. This forces the enemy to live and work in protective clothing for long periods, with accompanying reduction in efficiency, loss of morale, and great risk of heat illness.

PROTECTION

The commander of troops in desert operations where there is a threat of nuclear, chemical, or biological warfare must choose between the following:

- Troops remain unprotected, with a high casualty risk but chance of heat illnesses is lessened or,
- Troops are fully or partially protected, with increased probability of heat illnesses, dehydration, or prickly heat.

A decision on what level of protection is to be adopted can only be made according to the circumstances at the time. If full or partial protection is ordered, the pace of physical work will be slower and soldiers performing duties involving the senses will operate at reduced proficiency. The bulk of strenuous physical activity must be done at night or in the coolest part of the day. Rest periods (preferably out of the contaminated area) must be increased and soldiers should be given every opportunity to shave, bathe, and change clothing. When protective clothing is being worn, at least 10 degrees should be added to the WBGT index before safe levels of activity and water supply are calculated.

DESERT CONCEALMENT AND CAMOUFLAGE

As previously described, deserts generally do not offer much natural concealment or means for camouflage. It is necessary, therefore, to make maximum use of any artificial means available to the force.

VEHICLES AND AIRCRAFT

Movement of vehicles produces dust, diesel plumes, and distinctive track marks. The slower the speed the less the dust; however, the need for speed must be balanced against the dust that may be produced. Drivers must avoid harsh use of accelerators, the main cause of diesel plumes.

Shine from optical instruments (which should be kept shaded), matt paint polished by continual wear, or from tracks, particularly if rubber blocks have been removed, is a problem during the desert day. Running gear on tracks that has been polished by wear should be covered with burlap when stationary.

Disruptive pattern painting for vehicles and aircraft, including colors and patterns to be used, are described in TC 5-200. Local material can also be used. Color and texture of local terrain is best represented by dirt on vehicles, using a little water to make it stick. The effects are increased by covering a vehicle with wide-mesh net to which is attached local vegetation. The local/natural vegetation should be attached by foliage brackets. Twine or wire may be used as an alternative to the net provided vegetation is available.

Some or all of the following equipment should be available for every vehicle and aircraft although aircraft will not necessarily be able to carry all of it:

Desert Camouflage Net. The standard net used in temperate climates is wide mesh, garnished with narrow multicolored strips running in different directions. It relies on the casting of irregular shadows to break up outline. Such a net is *not* suitable for desert operations. The preferred net is the light weight camouflage screening system (LWCSS), desert version, which provides concealment against visual, near IR, and radar target acquisition/surveillance sensor devices. Additionally, the transparent version of the LWCSS allows US units to camouflage radars (less CW type radars) without degrading operations. A desert camouflage net should be a *complete cover*, as it depends on its imitation of the ground surface, both color and texture, for its effect. The alternatives, in order of priority, are as follows:

The specially produced desert pattern net of the light weight screening system.

An open weave cloth, colored as appropriate to the soil or "patched," stitched to an ordinary wide mesh net and used with the string uppermost. This provides both color and texture and can be suitably garnished with radar-scattering plastic, such as that used in the light weight screening system, and with any existing local vegetation.

A cover of close weave cloth colored as appropriate.

A standard net garnished solid, threaded in long straight strips that have been colored to harmonize with the terrain. The garnishing must be maintained.

The number of nets issued depends on the size of the equipment to be covered, but should be sufficient to allow a gradual slope from the top to earth of not more than 15 degrees. Each company size unit should be equipped with a spray gun and various tints of paint to provide for temporary variations in net color to match the terrain.

When using nets for stationary equipment:

Do not allow nets to touch sensitive items such as helicopter rotor heads and radio antennas which may cause a net to catch fire.

Do not pull nets so tight that each supporting pole stands out.

Ensure the net does not prevent the equipment from fulfilling its primary task. In some equipment such as helicopters, a net must be easily removable to reduce reaction time.

Avoid straight edge patterns on the ground, which indicate something is there.

Burlap. Burlap, which is also spray-painted in a nondescript desert color, is used to cover all reflecting surfaces, *excluding* fire control optics, and shadow-producing areas under vehicle bodies including tank suspensions. Aircraft equipped with windscreen covers will not require it.

Poles. Poles, natural or man-made, are used to raise the nets from the equipment, thereby hiding its shape. They must be brought into the area of operations by the force and will be extremely difficult to replace in the desert if lost or damaged.

Mushrooms. A "mushroom" is made locally of thin iron tubing, resembling an open umbrella without its cover and with the end of the spokes joined together. Slotted into a socket which has been welded on to the top of a tank, self-propelled gun, or personnel carrier, it lifts the net above the vehicle, concealing its shape, increasing air circulation, and permitting the crew or team to use the top hatches.

Pegs and Pins. Wooden pegs or long steel pins are used, depending on soil consistency, to hook and hold a camouflage net to the ground away from the vehicle.

Machetes. These are used to cut desert scrub if it exists in the immediate area.

Mallets. Mallets are required to drive pegs and pins into the ground.

After dismounting local security, camouflage is the first priority when a vehicle halts. Actions to be taken are:

Site in vegetation or shadow is available.

Cover shiny surfaces and shadow areas with burlap screens.

Drape net.

Add any available vegetation to net.

Blot out vehicle tracks for 50 meters behind vehicle.

Stationary aircraft take a relatively long time to conceal as they are fragile in comparison with other equipment, have a considerable heat signature, and must also be readily accessible for maintenance. The more they are concealed the greater their response time is likely to be. Tactical flying is discussed in appendix C, but when approaching a landing site where aircraft will stay for some time the following actions should be taken in sequence:

The aircraft must approach the site terrain-masked from enemy surveillance.

It must be closed down as soon as possible.

All reflective surfaces are covered.

It should be moved into shadow if it can be towed or pushed.

Depending on type, the main rotor should be shifted until it is at an angle of 45 degrees with the fuselage and a net draped over rotor and fuselage. The rotor must be picketed to the ground.

The remainder of the aircraft is concealed.

POSITION SELECTION

Position selection is critical, at every level. One of the fundamentals of camouflage, in any environment but particularly the desert, is to fit into the existing ground pattern with minimum alteration to terrain. A wadi bottom with vegetation or a pile of boulders that can be improved with grey burlap and chicken wire are good examples. Sites chosen must not be so obvious that they are virtually automatic targets for enemy suppressive fires, and antennas must be screened against the enemy if possible. Existing trails should be used and new trails should blend into old ones.

Shadows, particularly in the morning and evening, identify objects, so equipment must be placed in total shadow (rarely found) or with its maximum vertical area towards the sun so that minimum shadow falls on the ground ("maximum vertical area" is the rear of a 5-ton truck with canopy, but the front of an M88, for example). The shadow can be broken-up, which is normally achieved by siting next to scrub or broken surface such as rocks. Equipment should not be sited broadside to the sun and it is usually necessary to move as the sun moves. Digging-in reduces the length of any cast shadow.

Vehicles passing over pebble or heavy ground surface press the pebbles or gravel into the soil causing track marks to be prominent when viewed from the air. Avoid such areas if possible.

Soil texture suitable for digging must be a consideration when reconnoitering for battle positions. Holes must be covered to avoid cast shadows. If vehicles will be in position for more than a day, trenches should be dug for them.

In forward areas, tactical operations centers are probably the most difficult positions to hide although their need for concealment is great. They require strict camouflage discipline. Vehicles and aircraft should not be allowed to approach closer than 300-400 meters. They must be dispersed and concealed so nets may have to be readily available for aircraft. Special attention will have to be paid to lights and noise at night. Generators will have to be dug-in and radios and antenna systems must be remoted as far out as possible, in different directions.

FIELD ARTILLERY

Enemy target acquistion capability and counter-battery fire poses a major threat to field artillery units. Survivability will be greatly increased by timely movement and dispersion.

A method that may be used to establish an SOP to react to enemy counter-battery fire is: When effective fire is about to be brought on a unit (i.e., unit bracketed by adjusting rounds) or effective fire is brought on the position, a firing battery could immediately disperse on signal or automatically. Dispersal should be in a prearranged pattern. The unit would then regroup and move to and occupy a previously selected position. The battery should be organized to maximize dispersal, stagger gun positions, and minimize ground storage, especially of ammunition. The ability to disperse instantaneously can significantly reduce vulnerability of firing batteries.

AIR DEFENSE ARTILLERY

Air defense artillery are priority targets for both enemy air and ground units. The HAWK CW radar is degraded by use of the LWCSS. Concealment of the HAWK will therefore be more difficult since the item must be free of camouflage. Additionally, concealment is difficult since all ADA weapons must be maintained in a high state of readiness. Air defense units must have to rely on:

Digging-in. Generators if dug-in must be allowed adequate air space for cooling.

Concealment of the vehicle but neither the weapon nor radar. Rocket booster motors may set camouflage on fire. Radars may be covered by radar-transparent light weight screening systems, if available.

Careful siting in the pattern of terrain. Other equipment should not be placed too close, to minimize the possibility of the enemy's attention being attracted to the site.

ENGINEERS

Engineer activity often precedes operations, which makes it important that such work be concealed from enemy surveillance. The following guidelines should be used:

Minimum number of equipment and personnel are employed.

Equipment not in use on the site should be kept well away from it, dispersed, and concealed.

All possible preparation must be completed well away from the site.

The ground pattern should be followed if possible.

TRAINS

Trains must rely on concealment to provide a large part of their protection. The following guidelines will assist unit commanders to conceal trains while stationary or on the move.

All vehicles of a given type should look alike. This will make it difficult for an enemy to pick out critical vehicles such as water and fuel trucks in a column. Canopies over fuel trucks not only disguise them but also prevent radiant heat striking the fuel containers.

Vehicles should follow the tracks of the preceding vehicle if it is possible to do so without breaking through the crust, as

this makes it impossible for an enemy intelligence interpreter to calculate how many vehicles have passed.

Noise must be suppressed. Cab doors for example, may be removed to avoid the possibility of slamming.

Exhaust systems should be screened to reduce heat signature.

Vehicles must never form a pattern either when stationary or on the move.

SUPPLY POINTS

A supply point is likely to be in such a location that its main threat will be visual, either by eye or photograph. Normally greater emphasis can be placed on selecting positions from the point of view of concealment rather than tactical efficiency, particularly in situation where air defense cover may be limited. The following guidelines should be used:

Stocks are irregularly spaced both in length and depth to the maximum extent possible so that there is no definite pattern.

Stocks are piled as low as possible and preferably dug-in (for example, a pile of gasoline cans should be only one can high).

The shape of the area should *not* be square or rectangular, but follow the local ground pattern.

Stocks should be covered with sand, gravel, burlap, netting, or anything else that harmonizes with local terrain and the sides should be gradually sloped with soil to the top of the dump.

The contents of each supply point should be mixed so that the destruction of one will not cause immediate shortage of a particular commodity.

The location should be selected where trails already exist. Vehicles must use existing trails to the extent possible.

OPERATIONS IN HOT BARREN MOUNTAINS

Mountain operations are described in detail in FM 90-6. This appendix describes special conditions associated with operating in hot barren mountains such as those in the southern Sinai and on the shores of the Red Sea. It does not address tactics and techniques for mountain operations that are equally applicable to all mountains, except for purposes of clarity.

TERRAIN

Hot barren mountains are high and rugged, with very steep slopes. Valleys running into a range become more and more narrow with the sides becoming gradually steeper. Valleys are usually the only routes that allow ground movement of men and equipment at any speed or in any quantity. Water is nonexistent on hilltops and unusual in valleys except during flash floods after rains. Lateral ground communications are limited unless the force is moving across the spines of mountain ranges. Navigation may be difficult, as maps are likely to be inaccurate.

PERSONNEL

Troops operating in mountainous country must be in peak physical condition. Regardless of their normal method of movement, they require stamina, energy, and the ability to conduct sustained physical exertion and recover from it quickly.

Acclimatization is described in chapter 3 and appendix H. Acclimatization to height, which varies much more between individuals than that for heat must also be considered for operations in hot barren mountains. Lack of oxygen at high altitudes can cause unacclimatized troops to lose up to 50 percent of their normal physical efficiency when operating in altitudes over 6,000 feet. Mountain sickness may occur at altitudes over 7,800 and is characterized usually by severe headache, loss of appetite, nausea and dizziness, and may last from 5 to 7 days. Troops can acclimatize by appropriate staging techniques (TC 90-6-1,"Military Mountaineering"). It may take several weeks to become completely acclimatized, depending on altitude and the individual's personal physical reactions.

The risk of sunburn, particularly to the uncovered face, is greater in mountains than on the desert floor due to thinner atmosphere. Antisunburn ointment must be used and the face should be kept in shade around midday, using face nets or sweat rags. An individual camouflage net or scarf is particularly useful for this purpose. The fact that men are overheated may not be so apparent as at lower altitudes because sweat evaporates very quickly. Measures to avoid dehydration and salt loss are extremely important. Daily temperature variations may be considerable and it is necessary to guard against soldiers becoming chilled at night. Soldiers who have been sweating heavily before the temperature starts to drop should take off wet shirts and place them over relatively dry shirts and sweaters.

Requirements for hygiene are as important as in the desert itself. Normal rocky ground will make it extremely difficult to dig any form of latrine; excreta should be covered with rocks in a specially marked area.

ENVIRONMENTAL EFFECTS ON OPERATIONS

Objectives. Objectives are normally dominating terrain from which the enemy can be pinned down and destroyed.

Employment of Infantry. Infantry is the basic maneuver force in hot barren mountains. Mechanized infantry is confined to valleys and foothills (if these exist), but their ability to dismount and move on foot enables them to reach almost anywhere in the area. Airmobile infantry can also be extensively used. Consideration should be given to modifying the TOE of infantry units operating in barren mountains. A strong antitank platoon may not be necessary. However, infantry require extra radars and radios for the number of observation posts and separate positions that they may expect to occupy.

Tanks and Armored Cavalry. Hot barren mountains are not a good environment for tank and armored cavalry operations, because tanks and armored cavalry are unable to maximize their mobility, flexibility, and firepower.

Mobility and Maneuver. Avenues of approach at ground level are few. Roads or trails are limited and require extensive engineer effort to maintain. Off road trafficability varies from relatively easy to very difficult. Most movement and maneuver in this type of terrain is either by air or on foot. Unnecessary vertical foot or vehicle movement should be avoided. Rock slides and avalanches, although not as common as in high cold mountains, do exist and can restrict movement.

Reconnaissance and Security. Air cavalry is the major reconnaissance means but must guard against being ambushed by ground troops located at their own altitude or even higher. Security of units must include observation, *especially at night*, of all avenues of approach including those within capabilities of skilled mountaineers. Consideration should be given to the use of remote sensors (REMS) and radar for the security of the unit.

Cover and Concealment. It is relatively easier to conceal troops in barren mountains than on the desert floor due to rugged ground, deep shadows especially at dawn and dusk, and difficulties an observer has to establish perspective. Carefully placed rocks can be used to hide equipment; although they can chip and splinter under small arms fire. The normal type camouflage net, which breaks up outline by shadow, may be used rather than the overall cover used in desert.

Employment of Aircraft. Helicopter units of all types can be used; although they may be slightly inhibited by altitude and rugged terrain. Payloads and endurance are degraded due to density and altitude. Winds are turbulent with considerable fluctuations in air flow strength and direction, particularly on the lee side of mountains and this, combined with terrain, produces extra strain on crews as they have little margin for error. Flight crews should receive training in these conditions before being used for operational flying.

Navigation. Navigation by men on foot is a matter of making best use of available maps, together with the lensatic compass and a pocket altimeter. Air photographs can help; they should, however, be scaled and contoured.

The pocket altimeter is essentially a barometer, measuring height by means of varying

air pressure. If a navigator can only establish his location in the horizontal plane by resection on one point, the altimeter tells him his height and thus his exact position. The instrument must be reset at every known altitude as it is affected by fluctuation of air pressure.

Pilots may have difficulty navigating especially at night, and if several aircraft are operating in the same area. It may be necessary to provide hooded rear facing navigation lights. Visual communication, such as lights in varying quantities, patterns, or colors, can be used by troops on the ground to assist aerial navigation. Radio beacons placed on the highest available ground may also be necessary.

Combat Service Support. Supply of water and ammunition and the evacuation of wounded, especially if helicopters cannot land, can complicate operations. Water and ammunition may have to be transported by unit or civilian porters using A frames or other suitable devices, or even by animal transport such as camel or mule.

OFFENSIVE OPERATIONS

Avenues of approach are normally few, with very limited lateral movement except by helicopter. Reconnaissance must be continuous using all available means, as enemy defensive positions will be difficult to find. Observation posts are emplaced on high ground, normally by helicopter.

When contact is made, airmobile infantry can be used to outflank and envelop the enemy while suppressive fires and close air support are placed on all suspected positions, especially on dominating ground. Engineers should be well forward, to assist in clearing obstacles. If airmobile infantry is unable to outflank the enemy, it will be necessary to launch a deliberate attack.

Frontal attacks in daylight, even with considerable supporting fires, have limited chance of success against a well emplaced enemy. Flank attacks on foot take a lot of time. The best opportunity is at night or in very poor visibility, but progress of men on foot will be slow and objectives should be limited. The force should make every effort to secure ground higher than enemy positions to allow the attack to be downhill. It may be possible to infiltrate to a position behind the enemy, preferably using the most difficult and hence unlikely route; although this is very slow it normally has the advantage of surprise.

The importance of dominating terrain, together with the enemy's knowledge that troops on the objective will be physically tired and dehydrated makes an immediate counterattack likely. Supporting weapons must be brought forward at once, preferably by helicopter, and casualties removed by the same method.

Airmobile and attack helicopter units are well suited for pursuit operations. They can be used to outflank retreating enemy, and set up positions overlooking likely withdrawal routes. Small engineer parties can be emplaced to block defiles and interdict trails. Close air support and field artillery are used to reinforce airmobile and attack helicopter units and to counter efforts by enemy engineers to create obstacles.

DEFENSIVE OPERATIONS

A defense from a series of strongpoints is normal in hot mountains, due to the need to hold dominating terrain and due to restrictions on ground mobility. Due to the amount of rock in the soil, it takes more time to prepare positions, and normally requires engineer support.

It is necessary to hold terrain dominating avenues of approach and any terrain that dominates a friendly position must either be held or denied to the enemy by fire. It may be necessary to stock several days' supplies, especially water, ammunition, and medical equipment in a position in case helicopters or supply vehicles are unable to reach it.

When a covering force is used, it is organized around cavalry reinforced with attack helicopters, supported by field and air defense artillery. Airmobile infantry operates on ridge lines. If the enemy closes on a battle position it is difficult to extract airmobile infantry so sheltered landing sites nearby should be available. In any event, extractions must be covered by air or ground suppressive fires. Stay-behind observers should be used to call down field artillery fires on targets of opportunity or just simply to report enemy activity. When tanks are a threat and terrain is suitable, the covering force is reinforced with tank-heavy units and antitank weapons systems.

Combat in the main battle area is usually a series of isolated actions fought by strongpoints on ridgelines and in valleys. Patrols are used extensively to harass the enemy and prevent infiltration; all possible routes must be covered. If the enemy attempts to outflank the friendly force, he must be blocked by attack helicopters, if available, or airmobile infantry.

Reserves should be kept centrally located and deployed by air to block or counterattack. If this is not possible, reserves may have to be split up and placed behind key terrain where they are available for immediate foot counterattack.

If retrograde operations are necessary, mountainous terrain is as good a place to conduct them as anywhere. More time is required to reconnoiter and prepare rearward positions, and they should be prestocked as much as possible. Unlike the desert floor where movement between positions is likely to cover relatively great distances, movement in these conditions is usually from ridge to ridge. Routes must be covered by flank guards, especially at defiles or other critical points, as the enemy will attempt to block them or cut off rear guards.

COMBAT SUPPORT

Field Artillery. It may be difficult to find good gun positions at lower altitudes due to crest clearance problems: so high angle fire is often used. The best weapons are light field artillery and mortars which are airmobile and can be manhandled, so they can be positioned as high as possible.

Field artillery observation posts are emplaced on the highest available ground, although in low cloud conditions it will be necessary to ensure that they are staggered in height. Predicted fire may be inaccurate due to rapidly changing weather conditions, making observed fire a more sure method for achieving the desired results.

Air Defense Artillery. Like field artillery, there is limited use for self propelled weapons in this environment, although some may be used in valleys. Airmobile towed

weapons allow employment throughout the mountainous area of operations.

Engineers. A major task for engineers, even in an airmobile force, is construction, improvement, and repair routes, and their denial to the enemy. Mining is important due to the limited number of routes. Lines of communication require constant drainage, and possibly bridging, to overcome the problem of flash floods.

Military Police. Because of the frequent interdictions of mountainous roadways, military police will experience multiple defile operations. Temporary traffic signing must be employed to expedite traffic movement to the front. The number of stragglers may be expected to increase in this environment. Because of difficulty in resupply, the supply points for water, POL, food, and ammunition will become especially lucrative targets for enemy attack. Military police rear area security elements must develop plans for relief and augmenting base defense forces.

COMBAT SERVICE SUPPORT

Transportation. Air transportation is the best means in mountain operations due to its mobility. It may be limited, however, by weather, enemy activity or scarcity of landing sites, so there should be alternative means available. Terrain permitting, wheel vehicle transportation should be employed as far forward as possible, using high mobility vehicles off main routes. Beyond the limits of wheel transport the only alternatives are animals (which may need to be acclimatized) or porters.

Employment of Trains. The composition and employment of trains in mountain operations is described in FM 90-6. Brigade trains should locate near an airstrip that can handle USAF tactical air lift. They are an obvious target for enemy air attack or artillery, or raids by enemy deep patrols, so adequate air defense and a coordinated area defense plan are necessary. Guards must be placed on all dominating terrain around the area, equipped with ground surveillance radars and STANO devices, and patrols should be employed outside the perimeter.

Supply. Supply points may be set up in the brigade trains area, to operate distribution points for class I, III, and V. However, where routes are limited it may be necessary to resupply totally by air from the DISCOM area.

The variations in demand of supplies from those in temperate climates are very much the same as those on a desert floor described in chapter 5. Differences are described below:

Class I. Mess trucks are not practical in this terrain. Food is either eaten cold or heated on can heaters. Each soldier should carry one day's emergency ration, to be used if the daily resupply does not arrive.

Class II. There is a high demand for footwear. Combat boots may be expected to last approximately 2 weeks in the harsh rocky terrain.

Class III. Individual vehicle consumption will be greater than normal. Aircraft fuel requirements are greater, but it should be possible for much of their refueling and servicing to take place well to the rear where resupply is relatively easy.

Water continues to carry a higher priority than food. Demand for water is approximately nine quarts per day per man as a minimum and sometimes considerably more. Soldiers should carry three canteens and every effort should be made to prestock water in positions or along routes.

Health Services. First aid at squad and platoon level is very important as corpsmen will not necessarily be able to reach individual isolated positions. It is easy to lose casualties in this terrain so a buddy system to keep watch on each individual should be a matter of SOP. Medical evacuation is most often by air. It is a comparatively long distance to the nearest helicopter landing site; teams of stretcher bearers will be required.

HEAT ILLNESS: PREVENTION AND TREATMENT

WATER REQUIREMENTS[1]

Activity	Typical Duties	Quarts per man per day for *drinking*[2]. WBGT index being used[3].	
		Less than 80 degrees	Greater than 80 degrees
Light	Deskwork. Guard duty. Radio operating.	6	10
Moderate	Route march on level ground. Tank operations[4].	7	11
Heavy	Forced marches. Route marches with heavy loads or CBR clothing. Digging in.	9	13

Notes.

1. This is a guide only.
2. Extra water will be required for cooking, vehicle radiators, etc.
3. 80 degrees Wet Bulb Globe Temperature (WBGT) = approximately 105 degrees Fahrenheit dry bulb temperature in a hot *dry* desert.
4. Dry bulb temperature inside a tank may be considerably higher than outside temperature. Vehicles of some countries have inside insulation, and some vehicles are equipped with air conditioning.

SALT REQUIREMENTS

Two methods of making up a solution of 0.1 percent salt in drinking water are described below. Table salt is used throughout, and the container should be vigorously stirred or shaken after adding the salt.

Addition of Table Salt to Water.

Table Salt	*Amount of Water*
2 ten-grain crushed salt tablets or	1-quart canteen
1/4 teaspoon	
4 ten-grain crushed salt tablets	2-quart canteen
1 1/3 level mess kit spoons	5-gallon can
9 level mess kit spoons or	36-gallon lister bag
3/10 pound	
1 pound	100-gallon tank
1 level canteen cup	250 gallons (in water trailer)

Addition of Saturated Salt Solution[1]

Amount of Solution	*Amount of Water*
1/2 canteen cup (quart size)	1-quart canteen
1 canteen cup (2-quart size)	2-quart canteen
1 mess kit spoonful	1 gallon[2]
2/3 canteen cup	36-gallon lister bag
4 canteen cups	250 gallons (in water trailer)

Notes.

1. To prepare the solution (approx 26 percent) dissolve 9 level mess kit spoons in 2/3 canteen cup of water.
2. Follow logical progression i.e., 3 spoonfuls to 3 gallons, 12 spoonfuls to 12 gallons, etc.

ACCLIMATIZATION

The following schedule shows work that may be performed during a period to acclimatize soldiers in the minimum time. Full acclimatization is attained most efficiently by graded, progressively increasing work in the heat over a period of approximately 14 days; rest days will be of limited value. The schedule should be modified consistent with local conditions.

Day	Less than 80 degrees WBGT		More than 80 degrees WBGT	
	Morning	Afternoon	Morning	Afternoon
	(All figures in hours)		(All figures in hours)	
1	1	1	1	1
2	1 1/2	1 1/2	1 1/2	1 1/2
3	2	2	2	2
4	3	3	2 1/2	2 1/2
5	Regular duty		3	3
6			Regular duty	

HEAT ILLNESSES

An individual who has already had a heat stroke or a severe case of heat exhaustion is more likely to fall sick again than one who has not suffered from these illnesses. Therefore an individual once affected should be subsequently exposed to heat stress with caution.

The following symptoms can be used to distinguish between salt depletion and water depletion.

Symptoms	*Salt Depletion*	*Water Depletion*
Duration of symptoms	3 to 5 days	1 day
Thirst	seldom	prominent
Fatigue	prominent	seldom
Cramps	prominent	none
Vomiting	prominent	none
Weakness	progressive	acute

ILLNESSES

Illness	*Cause*	*Symptoms*	*First Aid*
Heat Exhaustion	Excessive loss of water and salt.	*Cool moist skin, profuse sweating.* Headache, dizziness, vomiting, weakness, rapid pulse and breathing. May be slight rise in temperature.	Heat cramps are promptly relieved by replacing the salt lost from the body. Place individual in cool outer clothing. Give all water he will drink *slowly* in form of 0.1 percent saline solution. If cramps are very severe send him to hospital.
Heat Cramps	Excessive loss of salt from the body.	Severe cramps in limbs, back and/or abdomen, following exposure to heat. Body temperature remains normal.	Move patient to cool shaded place. Remove outer clothing. Elevate feet and either move legs up and down or massage legs. Give all water he will drink in form of 0.1 percent saline solution. Refer to medical officer.
Heat Stroke	Collapse of body cooling mechanism.	*Hot dry skin.* Headache, mental confusion and bizarre behavior, dizziness, weakness and rapid breathing and pulse. Temperature high (106 or more). May be unconscious.	*Medical emergency. Seek aid of medical officer at once.* The lowering of the patient's body temperature as rapidly as possible is the most important objective in the treatment of heat stroke. Move individual to shady place. Remove clothing. Sprinkle or bathe patient with cool water and fan to increase cooling effect. Massage trunk, arms, and legs. If evacuating to hospital, continue treatment on way.

REFERENCES

PUBLICATION INDEXES

Department of the Army Pamphlets of the 310 series should be consulted frequently for latest changes or revisions of references given and for new material on subjects covered in this manual.

FIELD MANUALS (FM)

5-20	Camouflage, Field Fortifications, and Organization of the Ground
5-100	Combat Engineer Operations
6-20	Field Artillery Tactics and Operations
7-7	The Mechanized Infanty Platoon and Squad
7-8	The Light Infantry Platoon and Squad
7-10	The Rifle Company, Platoons, and Squads
7-20	The Infantry Battalions
8-35	Transportation of Sick and Wounded
10-8	Airdrop of Supplies and Equipment in the Theater of Operations
17-12	Tank Gunnery
19-4	Combat Military Police Support, Theater of Operations
20-32	Landmine Warfare
20-60	Battlefield Illumination
t1-10	Field Hygiene and Sanitation
21-11	First Aid for Soldiers
21-40	Chemical, Biological, and Nuclear Defense
21-60	Visual Signals
21-74 (Draft)	Patrolling
21-76	Survival, Evasion, and Escape
23-3	Tactics, Techniques, and Concepts of Antiarmor Warfare
24-1	Tactical Communications Doctrine
29-2	Organizational Maintenance Management
30-5	Combat Intelligence
31-1	Employment of Unattended Ground Sensors
32-12	Army Forces in Amphibious Operations (The Landing Force)

(C) 31-40	Tactical Cover and Deception (U)
(C) 32-5	Signal Security (SIGSEC) (U)
(S) 32-10	USASA in Support of Tactical Operations (U)
38-1	Logistics Management
38-11 (CS3 Test)	Unit Supply Procedures
41-10	Civil Affairs Operation
44-1	Air Defense Artillery Employment
54-2	The Division Support Command and Separate Brigade Support Command
54-9	Corps Support Command (COSCOM)
55-413	Aerial Recovery of US Army and Air Force Aircraft
71-1	The Tank and Mechanized Infantry Company Team
71-2	Tank and Mechanized Infantry Battalion Task Force
71-100	Division and Brigade Operations (Mechanized/Armor)
90-1	Employment of Army Aviation Units in a High Threat Environment
90-6	Mountains Operations
100-5	Operations
100-10	Combat Service Support
100-26	The Air-Ground Operations System
100-30	Tactical Nuclear Operations
100-32	Tactical Electronic Warfare
100-5-1	Conventional-Nuclear Operations
101-5	Command and Control of Combat Operations

TRAINING CIRCULARS (TC)

5-200	Camouflage Pattern Painting
7-5	Land Navigation
7-50	Fighting Positions for Infantry Soldiers
30-1	Tactical Cover and Deception
90-6-1	Military Mountaineering

TECHNICAL BULLETINS (TB)

MED 175	The Etiology, Prevention, Diagnosis, and Treatment of Adverse Effects of Heat

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9-6140-200-12	Operator and Organizational Maintenance Manual for Lead-Acid Storage Batteries

INTERNATIONAL AGREEMENTS

TITLE	NATO STANAG	CENTO STANAG	SEATO STANAG	ABCA STANAG
Marking of Contaminated or Dangerous Land Areas	2002			124
Patrol Reports by Army Forces	2003			6R
Operation Orders	2014			17R
Method of Describing Ground Locations, Areas	2029			
Battlefield Illumination	2088	2088		108
Fire Coordination in the Land/Air Battle	2099	2099	2099	
Radiological Survey	2112		2112	

FM 90-3

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By Order of the Secretary of the Army:

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