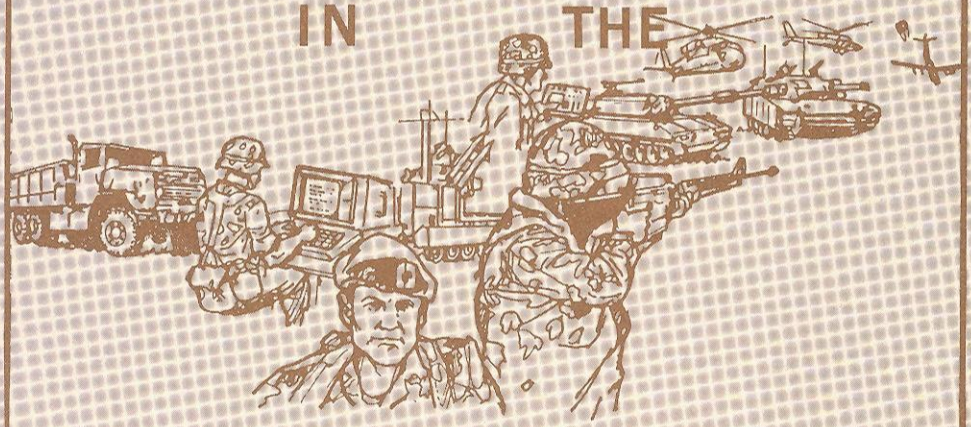
NEWSLETTER

No. 90-7 SPECIAL EDITION AUG 90

WINNING IN THE DESERT



CENTER FOR ARMY LESSONS LEARNED (CALL)
U.S. ARMY COMBINED ARMS TRAINING ACTIVITY (CATA)
FORT LEAVENWORTH, KS 66027-7000

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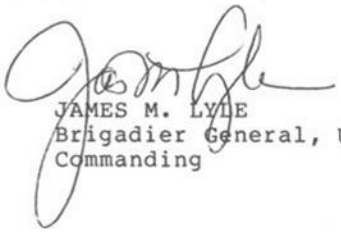
PREFACE

There are many problems associated with living and fighting in the desert environment. Throughout history, the Greek, French, British, and American forces have learned and relearned the problems associated with desert operations. More recently, observations gathered after the Arab-Israeli conflict of the 60s and 70s have provided, and validated, lessons learned and their impact on personnel, operations, and equipment in the desert. Desert conditions can force our military to re-evaluate and rethink operational plans. History and lessons learned will have an impact on how the U.S. Army performs in the future. Safety, survival, study, and common-sense thinking will lead to mission accomplishment.

This newsletter is a compilation of observations from the National Training Center (NTC), Exercise BRIGHT STAR, Saudi Arabia Lessons Learned (Army Materiel Command, 1983), and information extracted from the Center for Army Lessons Learned (CALL) data base. It gives insights on desert operations for both active as well as reserve component units. Although not all inclusive, the newsletter provides a solid basis for the planning process and generates discussion to support decisions in fulfillment of mission requirements.

It should be remembered that the principles and fundamentals of combat do not change in the desert. Priorities may alter, techniques will vary from those in temperate climates, but soldiers, leaders, and units who are fit and well trained to fight in other environments will have little difficulty adjusting to desert war. We have been training at the NTC since 1982, and know how to fight in the desert; practice what you have learned, review this newsletter, and read FM 90-3, Desert Operations, for additional help.

Training is the battle link!



JAMES M. LYLE
Brigadier General, USA
Commanding

WINNING IN THE DESERT



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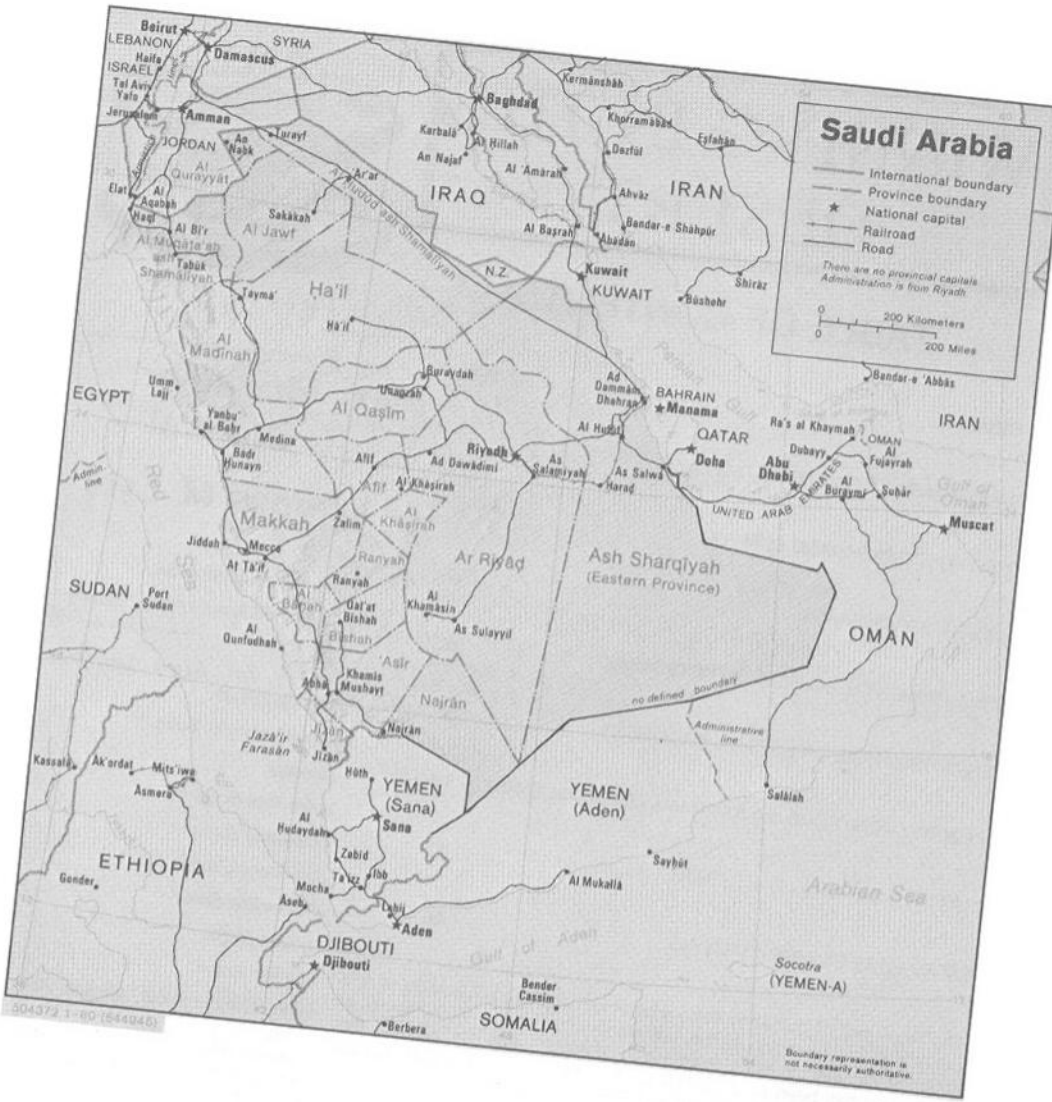
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Saudi Arabia
International boundary
Province boundary
National capital
Railroad
Road
There are no provincial capitals. Administration is from Riyadh.
0 200 Kilometers
0 200 Miles
Beirut
LEBANON
Damascus
SYRIA
Haifa
ISRAEL
Tel Aviv-Yafo
Jerusalem
Amman
JORDAN
Irbid
Ar'ar
Baghdad
Kermānshāh
Khorramābād
Eṣfahān
Karbalā'
An Najaf
Al Hillah
Al 'Amārah
Dezfūl
IRAQ
IRAN
Ahvāz
Bandar-e Shāhpūr
Abādan
Al Baṣrah
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KUWAIT
Būshehr
Shīrāz
Bandar-e 'Abbās
Elat
Al 'Aqabah
Ḥaql
Al Bī'r
Sakākah
Al Jawf
Tabūk
Tayma'
Ḥā'il
Al Madīnah
Buraydah
'Unayzah
Ad Dammām
Dhahran
BAHRAIN
Manama
Al Ḥufūf
QATAR
Doha
Ra's al Khaymah
Dubayy
Abu Dhabi
OMAN
Al Fujayrah
Al Buraymī
Ṣuḥār
UNITED ARAB EMIRATES
Muscat
EGYPT
Umm Lajj
Yanbu' al Baḥr
Medina
Badr Hunayn
Al Qaṣīm
Riyadh
Ad Dawādimī
As Salamiyah
As Salwá
Ḥaraḍ
Afif
Al Khāṣirah
Makkah
Zalim
Al Khāsirah
Jiddah
Mecca
At Ṭā'if
Ranyah
Ar Riyāḍ
Ash Sharqīyah
(Eastern Province)
SUDAN
Port Sudan
Al Qunfudhah
Qal'at Bishah
Al Khamāsīn
As Sulayyil
OMAN
'Asīr
Khamis Mushayt
Abhā
Najrān
no defined boundary
Administrative line
Jīzān
Jazā'ir Farasān
Kassalā
Ak'ordat
Mits'iwa
Asmera
Ḥūth
YEMEN
(Sana)
Sana
YEMEN
(Aden)
Salālah
Al Ḥudaydah
Zabīd
Ta'izz
Ibb
Mocha
Aseb
Lahij
Aden
Al Mukallā
Sayhūt
ETHIOPIA
Gonder
DJIBOUTI
Djibouti
Arabian Sea
Gulf of Aden
Socotra
(YEMEN-A)
Bender Cassim
SOMALIA
Berbera
Boundary representation is not necessarily authoritative.

WINNING IN THE DESERT

SAUDI ARABIA

GEOGRAPHY AND CLIMATE

Saudi Arabia is a large country. It occupies most of the Arabian Peninsula, an area about the size of the United States east of the Mississippi River. Its exact size is uncertain because many of its boundaries are not firmly defined. It is about 2,217,949 square km. The vast majority of its territory is desert.

Saudi Arabia has three great deserts. The Nafud in the north along the Saudi borders with Jordan and Iraq. The Ad Dahna runs from northern Saudi Arabia along the Saudi-Iraqi neutral zone south through the center of the country. The third and largest desert is the Rub Al Khali. The Rub Al Khali is over a half million square km in area and is located along the Saudi's southern border with Yemen and Oman.

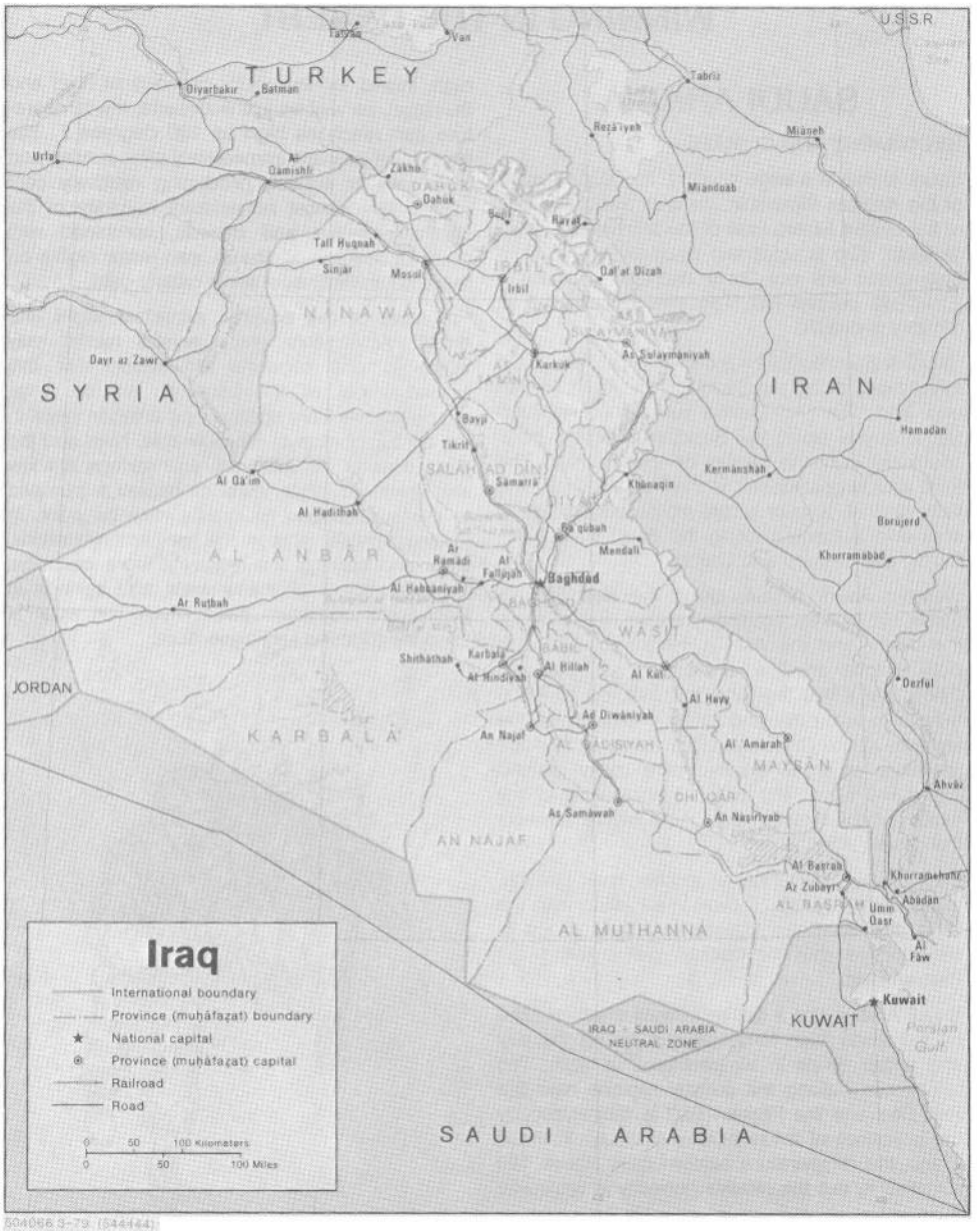
Western Saudi Arabia, along the Red Sea, is made up of two mountain ranges, the Hijaz in the north, and the Asir in the south. Although both ranges are low, the Hijaz rises between 2,000 and 6,000 feet and the Asir, up to 9,000 feet. Both are rocky and steep, especially on the western sides. On the eastern sides, both slope gradually down to an extensive rocky plateau called the Najd. The Najd extends east to the center of the Arabian peninsula where it meets the desert, Ad Dahna.

East of the Ad Dahna is another rock plateau, the Summan Plateau. Lower in elevation than the Najd, the Summan Plateau gradually drops in elevation to the flat coastal plains along the Persian Gulf.

Saudi Arabia has a desert climate characterized by extremely high temperatures during the day and sharp drops in temperatures at night. The temperature along the coastal regions near the Red Sea and the Persian Gulf is moderated by the presence of these bodies of water. In these areas, the temperature seldom rises above 100 degrees F, but the relative humidity is unusually high. Inland, on the rocky plateaus of Najd and Summan, as well as in the deserts, the temperature can reach as high as 130 degrees F. The heat gains intensity immediately after sunrise and dissipates at sunset, producing relatively cool nights. The almost nonexistent humidity of the central plateaus and deserts, combined with relatively low temperatures, can make nights on the Arabian Peninsula seem bitterly cold.

For most of the country, rainfall is slight and erratic. A region's entire annual rainfall may come in one torrential downpour. For this reason, most of the country's scarce water supply comes from springs and artesian wells. In the central portion of Saudi Arabia, Najd and the three deserts' natural wells and springs are few and scattered. Water must be hauled or pumped to the surface and its quality may be poor. In Eastern Arabia, and in the western mountains, wells and springs are relatively more common. Large numbers of these wells and springs in local areas constitute oasis where the water is used for irrigation and agriculture.





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IRAQ

GEOGRAPHY AND CLIMATE

Iraq's geography is discussed in terms of four main regions: the desert in the west and southwest; the rolling upland between the Tigris and Euphrates rivers (in Arabic, the Dijhis and Furat, respectively); the highlands in the northeast; and the central and southeastern alluvial plain through which the Tigris and Euphrates flow. Iraq's total land area is approximately 435,000 square kms.

The desert zone, lying west and southwest of the Euphrates river, is a part of the Syrian Desert. The region is sparsely populated and consists of a wide stoney plain interspersed with rare sandy stretches. A widely ramified pattern of wadis runs from the border to the Euphrates. Some wadis are more than 400 kms long, and carry brief, but torrential, floods during the winter rains.

The uplands region, between the Tigris north of Samarra and the Euphrates north of Hit, is known as Al Jazirah and is part of a larger area that extends westward into Syria, between the two rivers, and into Turkey. Water in the area flows in deeply cut valleys. Much of this zone may be classified as desert.

The northeastern highlands begin just south of a line drawn from Mosul to Kirkuk, and they extend to the borders with Turkey and Iran. High grounds, separated by broad, undulating steppes, give way to mountains ranging from 1,000 to 4,000 m near the borders. Except for a few valleys, the mountain area proper is suitable only for grazing in the foothills and steppes; adequate soil and rainfall make cultivation possible. Iraq's largest oil fields are located near Mosul and Kirkuk.

The alluvial plain begins north of Bagdad and extends to the Persian Gulf. The Tigris and Euphrates rivers lie above the level of the plain in many areas in this region. The whole area is a delta interlaced by the channels of the two rivers and by irrigation canals. Intermittent lakes, fed by the rivers in flood, also characterize southeastern Iraq. A fairly large area just above the merging of the two rivers at Al Qurnah and extending east of the Tigris beyond the Iranian Border is marshland, known as the Hawr al Hammerar. Much of it is permanent marsh, but some parts dry out in early winter, and other parts become marshland only in years of great flood.

Roughly 90 percent of the annual rainfall occurs between November and April, most of it in the winter months from December through March. The remaining 6 months, particularly the hottest ones of June, July, and August, at approximately 102 degrees F, are dry. The summer months are marked by two types of wind. The southerly and southeasternly Sharqi, a dry, dusty wind with occasional gusts of 80 km an hour, occurs from April to early June and again from late September through November. From mid-June to mid-September, the prevailing wind, called the Shamal, is from the north and northwest. It is a steady wind, absent only occasionally during this period. The very dry air brought by this Shamal permits intensive heating of the land surface by the sun, but the breeze has some cooling effect.

DESERT ENVIRONMENT

GENERAL: 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 this challenge. This newsletter describes characteristics of the desert, and its effects on personnel and equipment.

Deserts are arid, barren regions of the earth, incapable of support abundant plant life due to the lack of fresh water. Temperatures vary according to latitude and season. Day to night temperatures can vary as much as 70 degrees F. Some plants and animals have successfully adapted to desert conditions where annual rainfall may vary from 0" to 10," but this is often unpredictable. Desert terrain also varies from place to place, the common factor being lack of water.

TERRAIN

There are three types of deserts: Mountain, Rocky Plateau, and Sandy or Dune.

Mountain deserts have scattered ranges or areas of barren hills or mountains separated by dry, flat basins. High ground may rise gradually or abruptly from flat to a height of several thousand feet. Most of the infrequent rainfall occurs on high ground and runs off rapidly in the form of flash floods, eroding deep gullies and ravines, leaving sand and gravel around the edges of basins.

Rocky plateaus are relatively flat with places where solid or broken rock occurs at or near the surface. There may be cut or dry, steep-walled eroded valleys known as wadis in the Middle East.

YOU CAN'T DRINK TOO MUCH WATER!

Sandy or dune deserts are extensive, flat areas covered with sand or gravel, the product of ancient deposits or modern wind erosions. "Flat" is relative in this case, as some areas may contain sand dunes that are over 1,000 feet high and 10 to 15 miles long; trafficability in such areas will depend on windward/leeward gradients of the dunes and texture of the sand. Other areas may be totally flat for distances of 3,000 m or more.

DESERT DRIVING TECHNIQUES:

SAND: Sandy desert may be relatively flat or broken up by dunes. When driving in sand, the following techniques should be used:

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

DRIVERS, be wary of a lack of steering response in your tracks; this indicates that sand is building up between the rear sprockets and treads. If you allow this to continue, the sand will build up and force the track off. "Shaking" the vehicle with the steering or backing up will throw off the sand.

Vehicle loads must be evenly distributed. You should use rear wheel drive where necessary to avoid digging in the front wheels.

DRIVERS, switch to all wheel drive or change gears before a vehicle bogs down.

You should select a gear before entering sand that will allow your vehicle to keep as much torque as possible without causing the wheels to spin and to minimize changing gears.

Some areas will be covered by a surface crust. This is caused by chemicals cementing sand particles together. In some cases it will be possible to drive on this crust and keep the dust down.

Crossing dunes requires careful reconnaissance. Normally, the upwind side of a dune will be covered by a crust and have a fairly gradual slope. The downwind side will be steeper and have no crust. Before crossing a dune, you should climb it on foot, checking the crust thickness, the angle of the crest to ensure that

the vehicle will not become bellied up at the top, and the degree of slope and softness of the downwind side. If you are satisfied your vehicle can climb the dune, you should drive the vehicle straight up the dune 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. You should not try to drive wheeled vehicles through these areas without engineer assistance.

THORN AREAS: Cacti or thorn bushes will cause frequent tire punctures. When operating in areas with this type of vegetation, you will need to increase the number of tires carried in your 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 harsh jolting will wear you out and severely wear tracks, wheels, springs and shock absorbers. Vehicles can follow one another in this type of terrain, and it may be possible to reconnoiter and mark a route. DRIVERS, try to get a rolling effect as you cross large rocks by braking as your vehicle wheels ride over a rock so the axle settles relatively gently on the other side.

GETTING LOST OR STRANDED: People die every year in the desert because they don't know what to do if lost or stranded. It is a good idea to have at least two vehicles in your traveling party (use the buddy system). When driving, avoid going down steep slopes your vehicle may not be able to climb back up. Look for washouts, large rocks, and deep sand. If you get stuck, try jacking the vehicle up and then placing boards, brush, or blankets under the tires. Always let someone, friends or superiors, know where you are going, when you plan to return, and when to start searching if you don't return. Don't forget to check in when you return!

If lost, DON'T PANIC, remember the sun rises in the east and sets in the west. When departing from your field site, know the direction in which are departing. If needed, make a field expedient compass. Put a stick in the ground; lay a rock at the end of the shadow from the stick. Wait 15 minutes. Draw a line from the rock to the new end of the shadow. The line represents the east-west line. In the morning, the rock will be the west end; in the afternoon, the rock will be the east end.

If your vehicle breaks down, stay near it. Your emergency supplies are there. Your vehicle has many other items useful in an emergency. Raise hood and trunk lid to denote "help needed." A vehicle can be seen for miles, but a person on foot is very difficult to find. Tie a white or light-colored cloth to your antenna. Use mirrors and burn oil for signaling. When not moving, use available shade or erect shade from tarps, blankets, seat covers--anything to reduce the direct rays of the sun. Do not sit or lie directly on the ground; it may be 30 degrees or more hotter than the air. If you have water, DRINK IT. Do not ration it. If water is limited, keep your mouth shut. DO NOT TALK, eat, smoke, drink alcoholic beverages, or take salt. Keep your clothing on. It helps keep the body temperature down and reduces the dehydration rate. COVER YOUR HEAD. If a hat or cap isn't handy, improvise.

CLIMATE AND WEATHER

TEMPERATURES: The highest known air temperature recorded in deserts was 136 degrees F. Lower temperatures than this produced internal tank temperatures of about 160 degrees F in the Sahara Desert during World War II. The cloudless sky of the desert will permit the earth to heat up during the day, yet cool to near freezing at night.

WINDS: Desert winds can achieve almost hurricane force; dust and sand suspended within them can make life almost intolerable, maintenance very difficult, and restrict visibility to a few meters. Sometimes these winds can last for days at a time. Although there is no danger of

your being buried alive by a sandstorm, you can become separated from your unit. In all deserts, rapid temperatures changes invariably follow strong winds.

RAIN: The most common characteristic of all deserts is the lack of water. Rain, when it occurs, may consist of one single violent storm in a year. That causes high surface water runoff which, depending on soil consistency, will either reduce trafficability in loam of wadis 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 90s. Also, rain occurring as much as several hundred miles away can cause flooding in another distant location. Otherwise dry stream beds can suddenly become hazardous as a channel of flooding. Therefore, minimize the time you spend in these low-lying areas. Do not set up camp in dry stream beds; stories of walls of water 10 feet high roaring through them are true. Beware of rain clouds you see in the distance. Stay out of wadis!

LIGHTNING: Remember lightning does strike frequently in the desert. Again, don't panic, keep exposure down to a minimum. Track vehicles are grounded, so you're better off inside than running around in the open.

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. Look at the base of mountains when judging distances. Visibility conditions may, however, be degraded by mirages or heat shimmer, especially if you are looking into the sun or through optics. Because mirages distort the shape of objects, particularly in the vertical dimension, positions you selectfor observation posts should be as high as possible. Vision with night observation devices and even with the naked eye is extremely good on moonlit nights. A good way to measure distance is the use of the vehicle's odometer.

BEFORE PUTTING CLOTHES ON IN THE FIELD, CHECK FOR CRITTERS!

VEGETATION AND WILDLIFE

VEGETATION: The 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 sub-surface water. For example, a palm tree indicates there is water within 2 to 3 feet of the surface; salt grass implies that water is about 6 feet deep; cottonwood and willow trees indicate water at a depth of 10 to 12 feet. 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 the desert, but this fear normally disappears after acclimation.

INVERTEBRATES--(SPIDERS, CENTIPEDES, SCORPIONS): 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 scorpions and spiders, however, can cause death. When you camp, check your clothes and shoes before putting them on every morning; in heavy infested areas, they may invade these items at night.

SNAKES AND REPTILES: Snakes and reptiles are perhaps the most characteristic group of desert animals. Lizards and snakes occur in quantity, and snakes are probably the most common threat. Watch where you step. They are especially active at night during hot weather, and may be seen coiled in shady spots during the

day. DON'T PLAY WITH SNAKES!

FIRST AID FOR SNAKE BITE: Take no chances and treat all snake bites as poisonous. Follow these steps:

1. Remain calm, but act swiftly. Call MEDEVAC immediately.

2. Within practical limits, keep the bitten part very still, below the level of your heart and as cool as possible.

3. Tie a slightly tight band or tourniquet 2 to 4 inches toward the heart from where the bite is; you can use a belt, rag or sock and a stick. Keep moving the band ahead of the swelling if it moves closer to the rest of your body. Tie the band tight enough to halt blood flow in surface blood vessels, but not tight enough to stop the pulse.

4. If you estimate that you cannot get to medical attention within 15 to 20 minutes, make a cut over each fang mark. The cuts should be no more than a half-inch long and one-fourth inch wide. Make them along the length of the bitten limb (parallel).

5. Apply suction to the wound. If a snakebite kit is available, use its suction pump. If none is available, apply suction by mouth, spitting out the blood and other fluids frequently. The venom is not harmful in the mouth, unless there are cuts or sores. Even so, risk is not great. Suction should be kept up at least 15 minutes before loosening the tourniquet.

6. All snakebite victims should be taken to the hospital.

7. If bite is poisonous, and if MEDEVAC is not available, continue the process in item 5.

BE CAREFUL WHERE YOU SLEEP IN THE DESERT!

The desert has few areas that offer protection, such as trees, from large vehicles. During short halts, sleep in or on your vehicle. When halting for more than an hour or so, designate a sleeping area that has a protective perimeter and always let someone know where you plan to sleep. When moving vehicles into an area where troops might be sleeping, use ground guides to look for sleeping troops. Do not sleep directly on the ground; besides the ground being hotter than the air above ground, snakes, spiders, and scorpions will have more difficulty in getting to you if you're on a cot.

YOU USE LESS WATER IF YOU KEEP YOUR CLOTHES ON!



ENVIRONMENTAL EFFECTS ON PERSONNEL

GENERAL: There is no reason to fear the desert environment, and it should not adversely affect your morale if you are prepared for it, provided you take certain precautions to protect yourself and your equipment. It should be remembered that there is nothing unique about either living or fighting in the desert; 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 communications with equipment considerably inferior to that of today. The desert is essentially neutral, affecting both sides equally; the side that has better trained personnel for desert operations has a distinct advantage.

ACCLIMATION: Acclimation to heat is necessary to permit your body to reach and maintain efficiency in its cooling process. A period of 2 weeks should be allowed for acclimation, with progressive degrees of heat exposure and physical exertion. Although this strengthens your heat resistance, there is no such thing as total protection against the debilitating effects of heat.

SUN, WIND, AND SAND:

RADIANT LIGHT: The sun's rays, either direct or bounced off the ground, affect your skin and can also produce eyestrain and temporarily impaired vision. Overexposure will cause sunburn. People with fair, freckled skin, ruddy complexion, or red hair are more susceptible to sunburn than others, but all are susceptible to some degree. You should acquire a suntan in gradual degrees, in the early morning or late afternoon to gain some protection against sunburn. You should not expose the bare skin to the sun for longer than 5 minutes on the first day, and 5 minutes longer on each day thereafter. In all operational conditions you 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.

WOOD SHRINKS IN THE DESERT--MAKE SURE AXHEADS ARE SECURE BEFORE USING!

WIND: The combination of wind and dust or sand can cause extreme irritation to the mucous membranes, chapping the lips and other exposed skin surfaces. Irritative conjunctivitis (irritation of the eyes), caused by fine particles entering the eyes, is a frequent complaint of vehicle crews even when wearing goggles. Chapsticks and skins 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. Your body is also adversely affected by such factors as lack of acclimation, being overweight, dehydration, alcoholic excess, lack of sleep, old age, and poor health. Your body maintains its ideal temperature of 98.6 degrees F by conduction/convection, radiation, and evaporation (sweat). The most important of these in daytime desert is evaporation, since air temperature alone is probably above skin temperature already. If, however, relative humidity is high, air will not easily evaporate sweat, and the cooling effect is reduced.

SANDSTORMS: Fast, wind-blown sand can be extremely painful on bare skin, so this is one reason why you must always be fully clothed. When visibility is reduced by sandstorms to the extent that military operations are impossible, you should not leave your group unless secured by lines for recovery. You must carry pieces of

cloth or bandannas to help cover the face and neck during sandstorms. Windblown sand causes you to turn your head while driving and you'll be off course. Keep this in mind because you must compensate by buttoning up, taking constant compass readings, or using geographic reference points.

WATER, DEHYDRATION, AND SALT

WATER: Approximately 75 percent of the human body is fluid. A loss of fluid of two quarts (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.

FILTERS OF ALL KINDS NEED TO BE CHECKED OFTEN!

POTABLE (DRINKABLE) WATER IS THE MOST BASIC NEED IN THE DESERT. It is vital to ensure that there is no possibility of nonpotable (bad) water being mistaken for drinking water. Water that is not fit to drink, but not otherwise dangerous (it may have too much salt), may be used to aid cooling. It can be used to wet clothing so that the body does not use so much of its internal supply.

Issued water containers must be carried only for drinking water. Sufficient water must be carried on a vehicle to last you until the next planned resupply, plus a small reserve. In desert terrain, approximately 9 quarts of water per man per day is needed. When active, leaders need to force drinking of 2 quarts of water per hour.

It is a good idea to erect shade for water trailers--it lets the water stay much cooler.

You must train not to waste water. Water that has been used for washing socks, for example, is perfectly good for a vehicle cooling system.

Drinking water must be taken only from approved sources to avoid disease or water that may have been polluted. Care must be taken to guard against polluting water sources. If rationing is in effect, water should be issued under close supervision of officers, noncommissioned officers, and designated leaders.

You cannot be trained to adjust permanently to a reduced water intake. An acclimated soldier will need as much, if not more, water because he sweats more readily. If the ration is not sufficient, there is no alternative but to reduce physical activity or to restrict it to the cooler parts of the day.

In very hot conditions, it is better to take smaller amounts of water more often than to take large amounts occasionally. Drinking large amounts causes waste by excessive sweating and might cause heat cramps. As activity increases, you should drink more water. The best drinking water temperature is between 50 degrees and 60 degrees F. Lister bags or even wet cloths around metal containers helps to cool water. Alcohol and smoking cause dehydration and should be avoided.

SUNBURN CAN BE A KILLER IN THE DESERT!

WATER CONTAINERS: The best containers for small quantities of water (5 gallons) is plastic water cans. Water in plastic cans will be good up to 72 hours, compared to metal which will only be good for 24 hours. However, you should change the water in your canteen at least every 24 hours. Water in water trailers, if kept in the shade, will last up to 5 days. If the temperature outside exceeds 100 degrees F, the temperature of your water must be monitored, and when it exceeds 92 degrees F, it should be changed, as bacteria will multiply. If not changed, you will end up with a case of diarrhea. Ice in containers will keep water cool. If ice is put in water trailers, the ice in it must be removed before the trailer is moved as the floating ice in it will destroy the inner protection of the trailer.

LEADERS, check out your soldiers' water and make sure it is cool and still drinkable!

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 because it evaporates so fast that the skin will appear dry. Whenever possible, leave sweat on the skin to improve the cooling process. The only way to do this is to avoid direct sunlight on the skin. This is the most important reason why you must remain fully clothed.

Thirst is not an adequate warning of dehydration because the sensation may not be felt until there is a body deficient of 1 to 2 quarts of water. Very dark urine is often a warning of dehydration. You do not always drink the amount you need and may need to be encouraged to drink more especially during acclimation. NCOs and OFFICERS, be aware that you must keep track of how much your troops drink to ensure they drink enough water. Packets of artificial fruit flavoring will encourage consumption due to pleasant taste.

SALT: Salt in correct proportions is vital to your body; the more you sweat, the more salt you lose. Each MRE has enough salt for a soldier drinking up to 4 quarts per day. Unacclimated soldiers need more salt during their first few days, and all soldiers need additional salt when sweating heavily. As you sweat more, extra salt must be taken under medical direction. Too much salt may cause thirst, a feeling of sickness, and can be dangerous. To avoid this, follow these general rules:

You should take extra salt only in proportion to the water you drink.

The amount you take, in any form, must be strictly controlled according to medical advice.

DON'T DRINK UNTESTED WATER!

Salt tablets should only be used by dissolving two tablets per 1-quart canteen.

DESERT SICKNESS

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. Cleaning the areas of your body that sweat heavily is especially important; underwear should be changed frequently and foot powder used often. If sufficient water is not on hand, you may clean yourself with sponge baths, solution impregnated pads, a damp rag or even a dry, clean cloth.

HEALTH: You should be checked for signs of injury, no matter how slight, as the dust of the desert and insects can cause infection of minor cuts and scratches. Small quantities of disinfectant in washing water can reduce the chance of infection. Minor sickness in the desert can have serious consequences. Prickly heat and diarrhea can upset part of the sweating mechanism and increase water loss, making you more susceptible 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. Garbage is not to be buried within 100 feet of any source of water used for cooking or drinking. Burial area should be at least 30 yards away from the kitchen. Garbage pits 4 x 4 x 4 feet are suitable for 1 day for a unit of 100 men, and must not be filled more than 1 foot from the top. Trench-type latrines should be used if the soil is suitable, but must be dug several feet deep, because shallow ones become exposed in areas of shifting sand. They must be located at least 100 yards from unit messes and 100 yards from water sources. Latrines that are filled to within 1 foot of the surface must be closed. Excess dirt must form a mound 1 foot high, and the ground surface, 2 feet on either side, must be sprayed with an approved pesticide. The location must then marked with a sign "Closed Latrine" and dated.

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 mea-

sures. Typhoid and cholera can be prevented by vaccines. Typhus and plague are transmitted by fleas and lice carried by rats and other animals. Proper sanitation and personal cleanliness can help prevent these two diseases. Dysentery can be caused by drinking impure water and contaminated foods--all water to be used for drinking, cooking and bathing must be tested before use. Drink bottled water if available.

RESPIRATORY AND COLD WEATHER INJURIES: Some soldiers tend to stay in thin clothing until too late in the day and become susceptible to chills, so respiratory infections may become common. You should gradually add layers of clothing at night, such as sweaters, and gradually remove them in the morning. Where danger of cold weather injury exists in the desert, you must guard against inexperienced troops discarding cold weather clothes during the heat of the day.

HEAT ILLNESS: The temperature of your body is regulated within every 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's cooling mechanism will lead to heat stroke, which is potentially fatal. To avoid these illnesses, you must be physically fit, thoroughly acclimated, and drink sufficient water with necessary salt. If you expend more calories than you take in, you will be more prone to heat illnesses. Since you may lose the desire for food in hot climates, you must remember to eat, with the heavier meal of the day scheduled for the cooler hours.

Continued supervision by leaders 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 you to creep away from your buddies and attempt to hide in a shady and secluded spot; if not found and treated, you 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.

INFECTIONS FROM POLLUTED WATER: Skin diseases can be caused by polluted water. Untested water should not even be used for washing clothes, although it can be used for vehicle cooling systems or vehicle decontamination.

CLOTHING AND NECESSITIES: Standard lightweight clothing is suitable for desert operations, but should be a camouflage color, not fatigue green. Nonstarched, long-sleeve shirts and full-length trousers are worn, with pants tucked into combat boots. Special clothing may be required by tankers since they live in an environment of oils and greases with high risk of burns; this clothing must have an ability to "breathe." Jungle boots should not be worn because sand will sift into them. A piece of cloth should be worn loosely around the neck. It is used to protect the face during sandstorms, as a sweat rag, and to protect much of the face and neck against sun and sand. Each of you should have the following equipment:

Sweater, field jacket, a woolen scarf for cold and night use, and a cotton one for day use.

Sleeping bag.

Chapstick (or vaseline), antisunburn ointment, salt tablets, foot powder, and insect repellent. Eye lotion or drops are also useful.

Sunglasses and case (to prevent scratching when not in use).

Bottled water

A lensatic compress, if available.

Web belt with two quart canteens attached.

Goggles.

Combat boots will wear out quickly in desert terrain, especially if it is rocky. The leather will dry out and crack, unless a nongreasy mixture, such

as saddle soap, is used. 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 clothes will help to kill bacteria.

Vehicle exteriors and tools can get extremely hot when exposed to direct sunlight even for short periods of time. Crew members and maintenance personnel must wear gloves to prevent first and second degree burns.

DON'T LET SAND MIX WITH OIL--LIKE A GRINDING WHEEL, IT CAN WEAR METAL!



ENVIRONMENTAL EFFECTS ON EQUIPMENT

TRAFFICABILITY: Terrain varies from nearly flat, with high trafficability, to lava beds and salt marshes, with little or no trafficability. DRIVERS, be well trained in judging terrain over which you are driving so that you can select the best method of overcoming the varying conditions you will encounter.

Track vehicles are best suited for desert operations. Wheel vehicles may be acceptable because they will go many places that track vehicles can't 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 likely 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 protections are very useful.

The harsh environment requires a high standard of maintenance, which may have to be performed well away from specialized support personnel. OPERATORS, be fully trained in operating and maintaining your equipment. Some types of terrain can have a severe effect on suspension and transmission systems, especially those of wheel vehicles. Tanks tend to throw tracks on rocks. The unit PLL of tires should be considerably increased as sand temperatures of 165 degrees 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.

DON'T TOUCH EXPOSED METAL WITH YOUR BARE HANDS; IT'S VERY HOT!

WHEELED VEHICLES: On rocky deserts, the M54 5-ton truck is prone to air hydraulic cylinder failure and power-steering leaks. Tire consumption is very high, so all vehicles must carry one spare tire or preferably two spare tires, and the unit PLL of tires must increase considerably. About one of every three vehicles should carry jumper cables to provide for servicing dead batteries.

VEHICLES: Vehicle cooling systems 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 vehicle types are prone to excessive overheating, and ensure that extra care is applied to their maintenance. Temperature gauges will read between 10 to 20 degrees hotter than normal. Don't panic if your average operating temperature is 180 degrees, and when operating your vehicle, the gauge shows 200 degrees. Monitor the gauge. If the temperature keeps rising, put the vehicle in neutral and rev the engine up to approximately 1,200 RMPs until the gauge drops back down. You must check oil levels to ensure that levels are what is required (too high may be as bad as too low), that seals are not leaking, and that oil consumption is not higher than normal. You must keep radiators and air flow areas around engines 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 systems' hoses must be kept tight (a drip a second is 7 gallons in 24 hours). OPERATORS, do 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. You will have to adjust the battery specific gravity (sg) to this environment. The unit can either adjust its electrolyte to 1.2000 to 1.225 sg or obtain sulfuric acid, electrolyte, with an sg of 1.2085 - 1.2185. It may also be necessary to adjust the battery sg 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 at the lower end of the specifications.

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

AMMUNITION: You must keep ammunition away from direct heat and sunlight. If it can be held by bare hands, it is safe to fire. White phosphorus ammunition filler tends to liquefy at temperatures over 111 degrees F, which will cause unstable flight unless projectiles are stored in an upright position.

COMMUNICATION EQUIPMENT: Dust affects communication equipment such as 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.

RADIOS: All radios, regardless of type, must be kept COOL and CLEAN. They must be placed in the shade whenever possible and in a ventilated area. If water is available, lay a damp towel on top of the radios, making sure that the air vents are not blocked. RADIO OPERATORS, obtain a paint brush that you can use to keep your radios clean.

Desert tactics require dispersion, but the

environment is likely to degrade transmission ranges. This degradation is most likely to occur in the hottest part of the day. If you start to lose contact, especially if noon is approaching, you must have alternate ways to communicate.

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. Amplifiers are liable to severely overheat and burn out. Such equipment should be turned on only when necessary (they do not affect receiving), as they take approximately 90 seconds to reach the operating mode.

CHECK YOUR FEET DAILY--CHANGE SOCKS FREQUENTLY!

THERMAL CUTOUTS: Some items of equipment are fitted with thermal cutouts, which open circuit breakers when equipment begins to overheat.

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 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. Lubrication fittings are critical items and should be checked frequently. 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). Mechanics, you must keep your tools clean, and out of the direct sunlight, as hot tools are hot to handle. The use of high pressure hoses may force sand and dust into seals and bearings.

FILTRATION: It takes relatively 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 need replacement more frequently than usual. Engine oil 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 become worn should be protected with tape before insulation becomes worn. Sand will also find its way into parts of items such as "spaghetti cord" plus, either preventing electrical contact or making it impossible to join the plus together. You should carry a brush, such as an old toothbrush, to clean out such items before they are joined. Additionally, a pencil eraser will work wonders on antenna connections.

WEAPONS: Weapons may become clogged or missiles jammed on launching rails due to dust

and sand accumulation. Sand or dust clogged barrels can lead to inbore detonation. Muzzles must be kept covered by a thin cover so an explosive projectile can be fired through the cover without risk of explosion. Working parts of weapons must have the absolute minimum of lubrication. It may even be preferable to have them totally dry.

OPTICS: All optics are affected by blowing sand, which will gradually degrade their performance due to small pitting and scratches. Guard against buildup of dust on optics, which may not be apparent until the low-light performance has substantially deteriorated. It may be advisable to keep optics covered with some type of plastic wrap until operations determine their use. Whenever possible, use the soft brush in the BII to clean optics. If possible, use a low air pressure system to blow all sand out before wiping or dusting to prevent scratching of the lens.

SAND ACCUMULATION: 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 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 parts and mold in enclosed spaces such as optics. Bare metal surfaces on equipment not needed for immediate use must be kept clean and very lightly lubricated. Items such as optics must be stored in dehydrated conditions using dessicants; those being used should be kept where air can circulate around them.

DON'T DEHYDRATE--DRINK PLENTY OF WATER!

CONDENSATION: In deserts with relatively high dew levels and high humidity, overnight condensation can occur wherever surfaces, such as metal, are exposed to air that is warmer. This condensation can affect items such as optics, fuel lines, and air tanks. Fuel lines should be drained both night and mornings, and optics should 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 you inflate tires to correct pressure during the cool night, they may burst during the heat of the day. If fuel tanks are filled to the brim at night, they will overflow at midday. Servicing these items during the heat of the day can result in underpressures, overheating of tires, and a lack of endurance if the fuel tanks were not filled to their correct levels. Find the midpoint of the temperature range during the day and check pressures and fuel levels at that time of the day. Locate the fill line on fuel tanks and do not overfill.

CLEAN AIR FILTERS DAILY--DON'T LET SAND ACCUMULATE!

INSTRUMENTS: Precision instruments, such as range finders, may require adjustment several times during the day depending on the temperature variation.

STATIC ELECTRICITY: Static electricity is prevalent in the desert. It is caused by dry air coupled with an inability to ground electric charges due to dryness of the terrain. It is particularly likely with aircraft or vehicles having no conductor contact with the ground. The difference in electrical potential between separate materials may cause a spark between them, and if flammable gases are present, they may explode and cause a fire. A metal circuit must be made between tankers and vehicles being refueled; contact must be maintained during refueling, and the equipment must be grounded. A further hazard of static electricity is

with helicopter sling loads. The hook should be allowed to touch the ground before being loaded and a load grounded before being unhooked. It is also necessary to turn off all switches, uncouple electrical connectors, and ground all electrically operated weapons systems before rearming.



DESERT OPERATIONS, SAUDI ARABIA LESSONS LEARNED

TOPIC: **Rubber Deterioration**

DISCUSSION: Areas of packed sand and rock and lava beds occur more frequently in Saudi Arabia than in the soft sand desert imagined by many Westerners. This terrain shortens tire life. During each 3-day field training exercise it underwent in 1982, the Saudi Arabian National Guard (SANG) modernized 5th Artillery Battery registered a flat tire rate of 40 percent. The rate is about standard for all units. The majority of flats are attributable to the wear and tear of off-road travel rather than to road heat, high temperature, dryness, potholes, or abuse. Sharp rock itself rarely punctures a tire outright, but over a short period of time, it weakens the tire's structure by constant wear on the tread. It may be difficult to detect tire problems when a vehicle is moving fast over rough terrain. A simple, repairable puncture can result in a ruined tire and a bent rim. It is common to see large chunks of tread ripped away after travel over lava rock.

LESSON(S) LEARNED: Exercise extra care in driving over lava patches and rough ground. Check tires frequently for signs of wear and cuts. This will necessitate slower movement and tighter control over column spacing to prevent bunching at obstacles.

TOPIC: **Vehicle Recovery Operations**

DISCUSSION: A car or truck can be freed from soft sand by letting about one fourth of the air out of the trapped tires. Reinflate when freed. "Sand ladders" also can be used. These ladders are made of reinforcing rods welded to angle irons. They are about 2 feet long and the width of a truck tire. A shovel may be needed to free sand from around the trapped tires before the ladders can be inserted.

LESSON(S) LEARNED: Carry an air pump or

sand ladders and a shovel. If available, carry all three. (Sand ladders are usually carried in pairs.) Although underinflated, these improve vehicle traction in the desert. Tires are generally kept at normal road pressure to avoid damage to sidewalls from sharp rocks and to cut down on wear and tear. Increase the numbers of tow bars, ropes and matting in the unit and equip all tactical wheeled vehicles with winches (Note: Winching out a stuck vehicle has proven to be the most effective means of recovery). Another extrication procedure applicable to light vehicles stuck in very fine sand is the "rocking method." Pile sand around all four tires. Three to four men then violently "rock" the vehicle from side to side forcing the vehicle to bounce as high as possible. As the vehicles weight shifts from side to side, the piled sand will flow under the tires of the vehicle as it is rocked. Eventually, the vehicle will be raised back to the level surface.

TOPIC: **Effect of the Desert on Vehicle Mobility**

DISCUSSION: The choice of vehicle used in a desert operation has less to do with mobility than the skill of the driver. A relatively agile vehicle will sink up to the hubs if its driver insists on gunning the engine in soft sand. Conversely, a U.S. Dodge truck made for use on blacktop will perform acceptably off the road when operated by the driver adept at gearing, speed, braking, and steering. For all-around maneuver-ability regardless of driver performance, the British Leyland Land Rover is high on the list, and other support vehicles (U.S. Dodge and Austrian Steyr trucks) are rated below that. This assumes operation in a "mixed" desert of soft sand, packed sand, and rock. There is no resident experience in operating in dunes; however, it is suspected that, in extensive stretches of soft sand, support vehicles would be greatly slowed by bad footing. Sand and dust and "cap rock" that support the occasional vehicle can become impassable if several vehicles use the same route. The dust cloud also presents a safety problem in reduced visibility for vehicles following in a column.

LESSON(S) LEARNED: Well-trained drivers can maneuver a wide variety of vehicles over "mixed" desert without getting stuck. The majority of cross-desert travel should be on line or in echelon. Following another vehicle's tracks is not recommended except when crossing dry washes or as restricted by the topography.

TOPIC: **Vehicular Desert Survival Kit**

DISCUSSION: Military vehicles operating in a desert environment must have a higher degree of self-sufficiency than would normally be expected in a different environment due to the environmental extremes encountered.

LESSON(S) LEARNED: Vehicles should be equipped with the following:

1. OVE, to include a small general tool kit
2. Flashlight and highway reflector (triangular)
3. Fire extinguisher
4. Compass, binoculars and maps
5. Communications equipment
6. Shovel, sand ladders and tow rope/cable (at least 25 feet long)
7. Five gallons of water per vehicle occupant
8. Personal food, clothing and equipment
9. Siphoning hose (1/2-inch outside diameter by 6 feet) and funnel
10. Slave cables (one for each group of vehicles)
11. Mounted vehicular air compressor with air reservoir (150 psi) and sufficient air hose
12. Jack support plate (1 foot by 1 foot piece of metal)
13. Consumables, to include oil, radiator hoses, fan belts, heavy duty tape, air and gas filters, twine, annealed wire

TOPIC: **Observation at Great Distances**

DISCUSSION: A person standing on a hill 300 m high can see, depending on the landscape, for 20 or 30 km on a clear day. But land that looks flat from the hill actually has two ridgelines in that distance. The uniform color of the land and the even lighting at midday make it difficult to distinguish changes in elevation at great distances. The effect is similar at near range. Soldiers frequently aim at an enemy vehicle with a recoilless rifle without noticing the stretch of low ground in between. The round falls short. It is not a question of carelessness, but of optical illusion. This has an effect on range estimation and targeting.

LESSON(S) LEARNED: The casual observer will frequently miss intermediate features in the landscape. An observer must think about what he sees, and look for the unexpected. (Such problems in observation decrease at dawn and dusk, when shadows define terrain features.)

TOPIC: **Route Reconnaissance**

DISCUSSION: To compensate for a lack of adequate maps, it is best to reconnoiter desert operations areas in advance of large-scale troop movements. Route reconnaissance is especially important in field artillery. Alternate and supplemental positions should be seen ahead of time, and proposed and alternate routes should be gone over and marked. If at all possible, guides should return to the main element at the completion of the reconnaissance to help the unit adhere to the prescribed routes of march. Deviation from planned routes can cause lengthy delays and breakdowns that will ultimately degrade available fire support.

LESSON(S) LEARNED: Thorough ground reconnaissance and adherence to prescribed routes of march will improve artillery fire support in desert operations.

TOPIC: **Routes of March**

DISCUSSION: There are few hard surface roads within the interior of Saudi Arabia, and many of them are not well maintained. Secondary gravel roads and trails crisscross the landscape, but they too are not maintained and quite frequently are like driving on a "washboard." Except for the main arteries, there are few road signs or trail markers except those constructed by the Bedouins.

LESSON(S) LEARNED: Routes of march will quite often be cross-country over rugged and changing terrain with only partially adequate maps and a compass.

TOPIC: **TOW**

DISCUSSION: Some observers have complained that the TOW antitank weapon kicks up an excessive dust signature with its backblast. The complaint does not deserve a great deal of attention, since the TOW is such an effective weapon overall. If it is placed intelligently (that is, away from soft sand), its visibility to an enemy would be minimal. Furthermore, in the heat of battle, dust would be generated by anything moving. This would camouflage the signature made by TOW.

LESSON(S) LEARNED: TOW is a highly effective antitank weapon in the desert. Its dust signature, albeit a consideration, is not a serious drawback.

TOPIC: **High Failure Repair Parts**

DISCUSSION: Dust, sand, rough terrain and temperature extremes cause an estimated 50-percent increase in repair parts required to support a combat unit. In general, parts subject to friction fail with greater frequency in the desert than under U.S. or European conditions. In this category are practically all engine parts, brake shoes, upper and lower control bushings, wheel bearings, and carburetors. Carburetor failure can be forestalled by preventive maintenance. Vehicles parked for long periods in the sun tend to sustain damage to exposed plastic and rubber-like dashboard tops, wipers, and trim. Rubber seals are prone to dry rot. A combination of heat and dryness makes plastic parts in the engine compartment particularly susceptible to break-

age.

LESSON(S) LEARNED: Mechanics will need additional stocks of friction-bearing parts, plastic and rubber parts, and rubber seals. Also, cracking and breaking of cast metal parts is common due to constant excessive vibration during operations.

TOPIC: **Batteries**

DISCUSSION: Portable training devices and life support equipment that rely on batteries malfunction frequently unless the batteries are kept out of direct sunlight. Heat quickly discharges the stored energy in batteries. Although power generators are an alternative, they can also cause problems. When exposed to extreme heat, wind, and windblown sand, they become a maintenance nightmare. Specific devices immobilized by electrical problems for the above reasons include target mechanisms, radios, and remote control units. Vehicle batteries have been found to go dead after relatively short periods of vehicle inactivity (5 to 10 days).

LESSON(S) LEARNED: Whenever possible, hard-wire stationary electrical devices to commercial power sources. Exercise vehicles regularly.

TOPIC: **Vehicles Cooling Systems**

DISCUSSION: Operations in hot weather or on rough terrain increase the chances an engine will overheat. Lengthy high-speed operation, hard-pulling operations, and low-gear negotiation of steep grades or soft sand have caused overheating. Cooling system efficiency drops with the calcification of water channels caused by use of water with high mineral content. Poor cooling will also result from dirt between radiator cooling fans.

LESSON(S) LEARNED: Avoid continuous use of vehicles in low gear range. Replenish radiators with potable water except in emergencies. Blow dirt out of radiators with compressed air or a jet of water.

TOPIC: **Vehicle Filtering Systems**

DISCUSSION: Air, fuel, and oil filters require daily servicing in the desert. Ambient air that appears clean is actually laden with fine dust, even on a clear day. Replacement of all filters must be on a more frequent basis than recommended. Close attention to filters pays in fewer maintenance problems. It is not uncommon for an air filter to become completely useless in 3 days even with daily or more often cleaning.

LESSON(S) LEARNED: Greater numbers of filters of all types should be stocked for use in desert operations.

TOPIC: **Vehicle Lubrication**

DISCUSSION: Oil should be changed about twice as often as recommended, not only because grit accumulates in the oil pan but also because uncombusted low-octane fuel seeps down the cylinder walls and dilutes the reservoir.

Diluted oil lubricates and cools less effectively, and evaporates at high temperatures generated during engine operation, necessitating more frequent topping up. High-grade 20W-50 oil has served well in desert conditions.

LESSON(S) LEARNED: Oil changes and lubrication of undercarriage points at more frequent intervals will prolong engine and vehicle life under desert conditions.

TOPIC: **Lubrication of Weapons**

DISCUSSION: Some field-experienced personnel strongly believe that soldiers operating in the desert should not lubricate any weapon unless it is being taken into combat immediately. Conventional lubricants attract more dust and dirt than would accumulate if the weapon were left dry. There is no danger of rust most times of the year. Especially conscientious soldiers stuff oily rags down barrels or wrap the rags around jam-prone mechanisms. Weapons system manufacturers continue to recommend generous lubrication in their consulting visits to SANG, emphasizing that lack of lubricant affects the weapon

both in storage and in operation.

LESSON(S) LEARNED: Weapons should be lubricated in accordance with U.S. standards while in storage; however, when weapons are in use, they should not be heavily lubricated.

TOPIC: **Wire Deterioration and Usage**

DISCUSSION: Field wire (WD-1) is used to supplement 32-pair wire in the SANG field telephone system. Problems arise in attempting to maintain a continuous circuit and a reliable land-line communications system. Heavy vehicles driving over buried wire cause breaks and cuts. Dry rot on insulation exposes wire. It then will not conduct, or, at best, conducts poorly, resulting in dead or intermittently operational lines. Also, irregular tension on lines causes connections to pull away, breaking the communications link.

LESSON(S) LEARNED: Shielded cable is more sturdy and reliable than wire presently used by the SANG. Shielded cable is less prone to the problems listed above, and would more effectively maintain telephone communications under desert conditions.

TOPIC: **Eye Protection**

DISCUSSION: The importance of wearing eye protection in the desert cannot be overstressed. Some people prefer sunglasses, others like goggles. Both have advantages and disadvantages, but both accomplish the goal of keeping out direct and reflected sunlight and reducing the numbing effect of cold winter winds.

LESSON(S) LEARNED: Wear sunglasses or goggles in the desert.

TOPIC: **Consumption of Liquids**

DISCUSSION: Unacclimated Westerners dehydrate extremely rapidly in the desert. The only sure solution is forcing fluids--drinking even when not apparently thirsty on some sort of schedule, if possible. Experience indicates that if a man feels thirsty in the desert, he is already on the borderline of trouble. The Arabs drink a very sweet, hot tea. It is possible there is good reason to imitate them.

LESSON(S) LEARNED: Force liquids. Drink water even in the absence of thirst.

TOPIC: **Bad Water**

DISCUSSION: There have been a few cases among Westerners of gallstones and other urinary disorders following completion of extended periods in central Saudi Arabia. Some persons have drawn a link between the illness and the local water, which is high in mineral content. Purified water is available for drinking, but it is possible that it too might affect certain sensitive individuals.

LESSON(S) LEARNED: Expect a higher-than-normal incidence of urinary disorders, possibly as a result of poor drinking water.

TOPIC: **Effect on Eating Habits**

DISCUSSION: Fresh fruit and ice cream definitely raise people's spirits and brighten the menus on long maneuvers. It is a problem to transport and preserve these foods in the desert heat, but the payoff in improved morale is worth the trouble.

LESSON(S) LEARNED: Certain foods, though hard to keep under desert conditions, have intangible value to men in the field. These foods should be set aside before an operation for shipment to key elements at the right time.

TOPIC: **Jet Lag**

DISCUSSION: People arriving in Saudi Arabia from the United States need at least 2 or 3 days' recovery time after the long flight. Jet lag affects eating and sleeping habits, mental agility, and general attitude. A newcomer cannot "hit the ground running."

LESSON(S) LEARNED: Jet lag is a serious consideration in desert operations undertaken by men arriving by plane from a great distance. A recovery period should be allowed, ideally 1 day for every time zone crossed.

TOPIC: **Respiratory Disorders**

DISCUSSION: The air, even on a clear day, is laden with dust particles which trigger sinus problems and other respiratory ailments. It is not practical or feasible to attempt to filter out the dust particles on a daily basis; however, on particularly bad days, personnel do don surgical masks or cover their nose and mouth with a bandanna to reduce the intake.

LESSON(S) LEARNED: Expect a higher-than-normal incidence of respiratory disorders.

TOPIC: **Nonpotable Water**

DISCUSSION: Because local water in central Saudi Arabia is highly saline, supply units are often called upon to provide "sweet" water (that is, drinking water) for cleaning and maintenance. Saline water calcifies in automobile cooling systems, reducing cooling capacity. It corrodes metals when used for washing. There are isolated open wells in some of the wadis. Abundant water is only available from wells which are drilled to tap underground rivers and lakes at depths of 3,000 to 8,000 feet. The water from this source has an extremely high mineral content which makes it unsafe to drink.

LESSON(S) LEARNED: Plan on supplying unusually large quantities of drinking water because of the unsuitability of local water for drinking, cooking, cleaning and maintenance. Experience in the SANG battalions indicates that a unit will require at least 7 gallons of water per man per 24-hour period.

TOPIC: **Fuel Contamination**

DISCUSSION: One source of fuel contamination is the reuse by the SANG of gasoline tankers to transport or store diesel fuel, and vice versa, without first flushing. The Saudi government-owned fuel company, Petromin, controls the only facility in the country for flushing out tankers. Because there is no other place perform this service, the pressure of operational necessity often forces driver to skip this important procedure.

LESSON(S) LEARNED: If a unit is required to flush a tanker to transport a different product, the availability of local facilities should not be included in the planning.

TOPIC: **POL Storage**

DISCUSSION: Operation of mechanized forces in the desert will require a considerable number of POL storage sites. In most desert areas in Saudi Arabia, storage systems are antiquated. Devices for determining the state of POL contamination may be lacking. As an example, local systems are not equipped with sampling and gauging hatches. Standard U.S. sample beakers will not fit down refill hatches. The local storage tanks also have no strapping charts for determining the precise volume from tank fluid levels. Bottom samples cannot be drawn up to test for contamination.

LESSON(S) LEARNED: It is not possible to determine the precise volume of fuel in local storage tanks or to determine the degree of contamination without special equipment.

TOPIC: **Ammunition**

DISCUSSION: Experience indicates that artillery ammunition is consumed in greater quantities than would normally be expected in a different environment. This is due to the expansive open terrain upon which an engagement would probably occur. Erratic ballistic behavior has been observed on artillery and tank rounds due to excessive heat.

LESSON(S) LEARNED: Increase consumption planning for artillery and antitank ammunition. Ammunition should be stored in areas with a double sun shade. Wherever possible, in addition to the double sun shade, the ammunition should be stored approximately 1 m below the desert floor. This method reduces the ambient temperature in the storage site below 100 degrees F.

TOPIC: **Desert Fog**

DISCUSSION: In the desert, temperature fluctua-

tion and moisture in the air may produce fog that forms a belt that may move rapidly through an area of operation or hang suspended for extended periods. In numerous instances, operations involving the SANG have been disrupted by this desert fog.

LESSON(S) LEARNED: Because visibility is cut to almost zero during desert fog, vehicle operations, land navigation, target acquisition, enemy observation, and direct fire are seriously affected. However, units with through knowledge of the terrain in their areas of operation can effectively use this fog to disengage from the enemy, or conduct raids or ambushes.

TOPIC: **Effects on Optics**

DISCUSSION: Optics in central Saudi Arabia are completely free of moisture-related problems. However, in areas adjacent to the Arabian Gulf and the Red Sea, problems with condensation and moisture occur more often than usual. The major threat to optics is wind blown sand, which gradually degrades its performance by pitting and scratching the lenses.

LESSON(S) LEARNED: Regular maintenance and inspection of optics will help eliminate or control moisture-related problems. Lens covers should be used to prevent damage from dust and blowing sand. If possible, keep the system completely covered until ready for use.

TOPIC: **Dispersion**

DISCUSSION: Any bunching of vehicles in open areas is easily detected at ranges up to 10 km from the air or high vantage points.

LESSON(S) LEARNED: Unit elements should be dispersed to the greatest degree possible using all available natural cover and concealment.

Tips on Fighting in the Desert

Intelligence

o Distances require longer lead times for reconnaissance and surveillance planning. Effective reconnaissance takes time.

o To confirm the intelligence template, the reconnaissance must identify (6-digit accuracy) approximately 80 percent of the enemy antitank systems.

o Scouts are reconnaissance patrols, not combat patrols, and should attempt to gain information through stealth.

o Consideration should be given to conducting reconnaissance during periods of limited visibility.

o Very few civilians are encountered in desert operations, and information they give should be treated with caution.

Maneuver

o When moving in the desert, cover can only be provided by terrain masking because of the lack of heavy vegetation or manmade objects.

o Because there is little vegetation in the desert, strong shadows are readily observed from the air.

o Disrupt shadows by altering the shape of equipment, using the correct angle to the sun to minimize shadow size and to cause shadows to fall on broken ground or vegetation whenever possible.

o Dig in equipment and use overhead cover or camouflage nets to reduce shadows.

o It is necessary to move vehicles and equipment as the sun moves.

o Shade optics to prevent shine.

o Open terrain and predominantly clear atmosphere generally offer excellent long-range visibility, but at certain times of the day, it may be limited or distorted by the effects of heat.

o The ideal observation position should have the sun behind it and be as high as possible to lessen the effects of mirages and heat radiation from the ground.

o Stake out your target line/engagement area (trigger point). This will prevent soldiers from engaging targets beyond the maximum effective range of the weapon system.

o Observation of fires may be difficult. The lack of visible terrain features distorts your ability to make range estimations.

o When preparing defensive positions, use every available means to know how far you can observe in front of your positions.

o The enemy can see just as far as you can. Inspect your position from an enemy point of view.

o Light and noise at night may be seen or heard from miles away, so strict light and noise discipline are necessary.

o Essential noise such as that produced by generator motors must be muffled and kept to the minimum by digging in or sand-bagging the generator.

o Sand and dust reveal movement in the desert. It is best to move at night. This includes resupply as well as tactical movements.

o Sand obscures landing zones, distorts depth perception, and can disorient pilots.

o There are fewer terrain features in the desert. This hinders navigation and exposes friendly forces to the enemy.

o Take advantage of the least considered features to conceal movement, such as wadis. Always camouflage positions.

Fire Support

o Artillery ammunition storage and handling is very important in a dry, hot environment. Very hot ammunition will affect the ballistic solution, which will cause the round to impact long or short of its intended target.

o Dig in storage positions for ammunition. This will keep it cooler.

o Illumination or smoke rounds can be used to reorient maneuver forces.

o The fire support coordinator is responsible for planning and coordinating all fires in the maneuver area of operations, i.e., mortars, Air Force, Marine Corps, and Navy CAS, naval gunfire, and attack helicopters.

Mobility/Countermobility/Survivability

o Units should use linear obstacles to stop enemy movement due to lack of natural obstacles and excellent trafficability of the entire region.

o Minefields must be rapidly laid over large areas to be efficient.

o The enemy will try to attack with the sun low and behind him in an attempt to dazzle the defender.

o Engineer units must plan on having two operators for each piece of equipment because of extra maintenance requirements and harsh working conditions.

o Especially in open terrain, survivability positions are normally more important than antitank ditches.

o A tank platoon properly dug into two step positions can destroy a battalion. As such, earthmoving assets should focus initially on survivability positions.

o Since infantry can dig themselves in, normally the infantry works on digging in before assisting the engineers in the emplacement of mines. The engineer soldiers normally focus entirely on obstacles.

o Once the task force completes crew-served positions with overhead cover, it reinforces the engineer soldiers emplacing obstacles to the maximum extent possible.

o Employ "basic loads" of Class IV (sand bags, pickets, etc.) with all vehicles to expedite rapidly digging in. The S4 must push forward replacement basic loads during the transition to the defense in standard infantry platoon packages.

o In the desert environment, camouflage and dispersion are a necessity for all forces.

o Employ reverse slopes as much as possible and camouflage frontal parapets for individual/crew positions. This avoids the obvious bunker positions easily seen and destroyed by direct fire.

o Strong winds increase the evaporation rate of liquid agents and cause chemical clouds to act similarly to radio active fallout, over shorter distances.

o Extended depth and dispersion of vehicles will enhance your chance of survival.

o MOPP discipline and soldier reaction to chemical agents will enhance survivability.

o Engineers should carefully reconnoiter routes of march to avoid needless destruction of roadways, bridges, and pipelines.

o Armored vehicles survive longer when dug in. If we fight outnumbered and win in the desert, we must stress survivability positions.

o Use of dummy positions can conceal operational plans to deceive the enemy as to real location of potential targets such as fighting positions or trains areas.

o High temperatures of the desert day increase the incapacitating effects of liquid agents, which rely on skin penetration, in a comparatively small area around the target.

o Air instability is most likely to cause quick, vertical, and irregular dissipation of an agent, leaving the target area relatively free of contamination quickly.

o Chemical weapons used during the heat of the day are normally persistent nerve or blister agent.

o Strong winds can increase the evaporation of liquid agents and cause chemical clouds to act similarly to radioactive fallout.

Air Defense

o Airspace management difficulties are compounded in the multinational environment. SOPs must be exchanged to formalize airspace policy.

o Adequate coordination with host nation forces within the BCE cannot be effected without host nation liaisons to the BCE.

o Camouflage and dispersion are of the utmost importance to air defense systems. Direct sunlight can also have an effect on the Stinger system.

Combat Service Support

o Medical support of the defense in the desert environment is associated with great distances. The depth and dispersion of the defense create significant time/distance problems.

o In a nonlinear desert defense, enemy and friendly units will be intermingled, especially in poor visibility.

o Medical treatment and evacuation will become more critical in the desert. The effectiveness of the combat lifesaver program has been proven.

o Medics must constantly recertify and train those who are designated as combat lifesavers. The standard should be at least one per squad.

o Rehearse how your unit will identify, treat, and evacuate casualties. This is as important as how you will fight.

o All weapons must be cleaned constantly.

o When not in use, keep weapons covered. Even though weapons are covered, they may still have sand on them. Clean the weapon frequently so it will be ready when needed.

o PMCS in the desert is absolutely essential. Left unattended, sand and wind rapidly destroy the most basic piece of soldier gear.

o Sand clogs fuel lines, wears out tires and other rubber and plastic parts faster. It also seeps into engines and cooling systems. This results in overheated engines which can cause sudden and catastrophic failure.

o Food service organizations require intense supervision. Current menus must be augmented with fresh fruit, vegetables, and breads to provide soldiers the roughage and nutrients they need.

Command and Control

o Commanders should attempt to operate where contact can be maintained with forward units in critical spots and with the TOC.

o Desert evenings can be extremely long or short. Leaders should be concerned with EENT, BMNT, and percentage of illumination. These factors will be extremely important when fighting night battles.

o Dry desert conditions can, at times, reduce radio signal strength and create unforeseen blind spots, even in aircraft operating nap of the earth.

o FM communications may be degraded due to dead spots caused by heavy concentrations of minerals close to the surface. Establish firm procedures for constant control, either by radio or through liaison.

o Ensure that all know the commander's intent and rehearse battle drill, so that actions are understood even in the absence of good communications.



Knowledge of Arab customs part of Middle East mission

U.S. Central Command Middle East analysts say the Arab people are sensitive about the basing of foreign troops on their soil. American forces are being advised to avoid any comments or actions that could lead anyone to believe that the U.S. deployment could be permanent.

Here are some of the guidelines for soldiers deploying to the Middle East regarding Arab customs, courtesies and gestures:

Alcohol--Moslem religion restricts the use of alcohol and it is prohibited by many host countries in the MiddleEast theater. Army officials say that in deference to the Arab hosts, alcohol will be prohibited. Pornography and sexually explicit literature is equally unacceptable in the Arab society, officials say, and is also prohibited in the theater.

Handshaking/Sitting --Shake hands whenever meeting an Arab, and when leaving him. Never sit and expose the sole of one's shoes or bottoms of feet to an Arab. It is regarded as an insult.

Conversation--Generally take the lead from what an Arab brings up in conversation, but avoid asking personal questions. Do not ask questions about the women of an Arab family.

Friendship--Arabs take friendship very seriously. The Arab concept of friendship is one of duration and intensity. Before an Arab enters into a friendship, he must find out all about a person to see how much influence one has and if the person might embarrass him. If someone misrepresents his background, not only will it affect credibility -- it can seriously harm the Arab's standing and that of his family. Remember, however, that the Arab system of friend-ship balances favors against obligations. When favors are asked by an Arab, never give a flat "no," it will signal a desire to end the friendship.

Touching--Touching and holding hands with members of the same sex in public is acceptable among Arabs and demonstrates friendship. Touching or kissing members of the opposite sex in public is considered to be in extremely bad taste or obscene.

Distance--Arabs stand very close to one another when talking. Westerners may find this uncomfortable, but do not back away.

Time--Do not be impatient with local people. If hurried, nothing will get done. However, late arrival for an appointment is a public insult.

Criticism--Unlike Americans, Arabs do not accept or give criticism directly. Even constructive criticism of an Arab's work or ideas in public is considered an insult. It is especially rude to contradict a person of status or a superior in rank or age. An Arab's ideas or suggestions should always be given recognition.

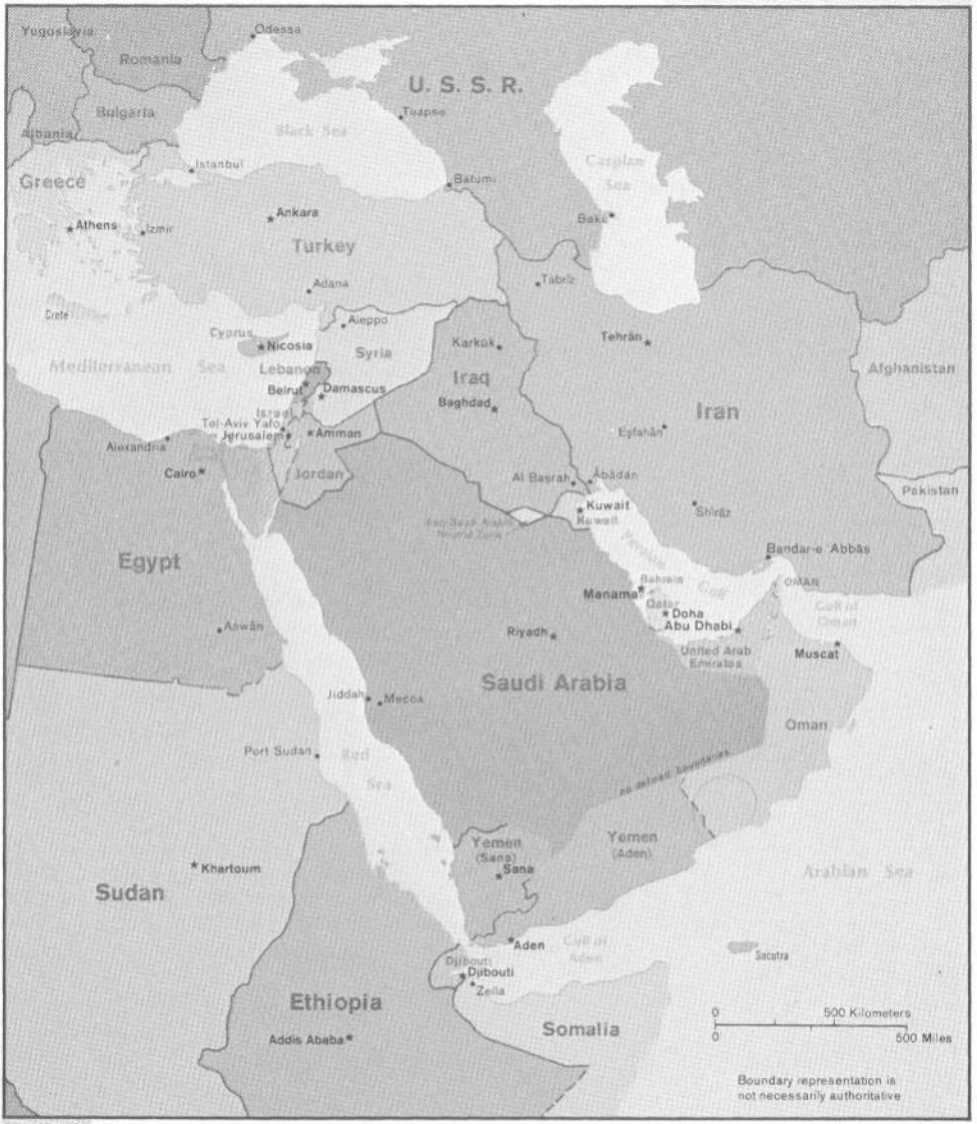
If criticism is required, take the Arab aside privately and gradually lead up to the subject in an indirect and very tactful manner. Arabs understand and appreciate tact because it protects public image and avoids insult.

Patronizing--Do not talk down to someone because he doesn't speak English well.

Photography--Do not take pictures of military or civilian-installations or equipment, military or civilian police, or civilian airport or seaport facilities without permission of the host country. Do not photograph people at close range (particularly women) without permission.

Women--Do not stare at or strike up a conversation with Arab women in public.

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