MCRP 3-35.2A

Small Unit Leader's Guide To Mountain Operations

U.S. Marine Corps

Coordinating Draft June 2000

DEPARTMENT OF THE NAVY
Headquarters United States Marine Corps
Washington, DC 20380-0001

XX June 2000

FOREWORD

1. Purpose. Marine Corps Reference Publication (MCRP) 3-35.2A, *Small Unit Leader's Guide to Mountain Operations*, is a reference on tactics, techniques, and procedures for small unit leaders in the mountain environment. Expertise in mountain operations cannot be gained solely from reading this publication. Practical application, training, and operational experience are necessary. This publication explains the basics of how to deal with the unique conditions imposed when operating in mountainous terrain.

2. Scope. While primarily aimed at infantry leaders from the company to fire team level, this publication is useful for small unit leaders of any ground combat element, combat support, combat service support, and aviation combat element units.

3. Supersession. None

4. Certification. Reviewed and approved this date.

BY DIRECTION OF THE COMMANDANT OF THE MARINE CORPS

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Chapter 1. Small Unit Operations in a Mountainous Environment

1001. Organization

Conventionally organized Marine Rifle Companies who are well trained in maneuver warfare are the ideal foundation from which to develop mountain troops. If every Marine receives additional training in basic mountaineering and selected individuals receive training in special skills, the company can be ready to fight and win in a mountainous environment. Most of the tactics applied in conventional warfare can be successfully employed in the mountains. The most important consideration and difference is the terrain, which has a tendency to require platoons and squads to act independently as the company moves into steeper and more rugged territory. Aggressive small unit leadership is key to success in the mountains. A Rifle Company has many of the assets it needs to be successful during combat operations in the mountains. Light, quick, and mobile, a company can use speed and maneuver to surprise the enemy

1002. Special Skills

In order to overcome many of the obstacles prevalent in the mountains, units will often need to temporarily reorganize themselves to allow specially trained Marines to tackle obstacles, while the rest of the unit provides security or carries out other missions. Such obstacles are cliffs, steep earth, rivers and gorges. Summer Mountain Leaders and Assault Climbers are trained to overcome all of these obstacles and Tactical Rope Suspension Technicians are trained to overcome the last two. All Marines need to be trained in the skills of the Military Mountaineer prior to deployment to a mountainous battlefield.

a. Military Mountaineer. This Marine has the ability to descend a rappel site, ascend vertical obstacles after an Assault Climber has set it up and to set up and cross a one-rope bridge over horizontal obstacles. Additional knowledge and technical skills required of the Military Mountaineer are the following:

Mountain Safety considerations in rough terrain.
Nomenclature and care of equipment.
Rope management.
Stream crossing.
Descend vertical obstacles.
Cross horizontal obstacles.
Ascend vertical obstacles.
Medevac procedures on rough terrain.
Operate raising and lowering systems.

b. Tactical Rope Suspension Technician (TRST). This Marine has all of the skills of the Military Mountaineer along with the following:

Care and maintenance of climbing equipment.

Establish natural and artificial anchors.
Conduct rappelling operations.
Conduct rope bridging operations.
Conduct vertical hauling lines operations.
Conduct suspension traverse operations.
Conduct medevacs on vertical terrain.
Demonstrate mastery of additional rope management techniques.

c. Assault Climber (AC). This Marine has all of the skills of the TRST along with the following:

Conduct two party climbing.
Conduct multi-pitch climbing.
Conduct military aid climbing.
Conduct two party climbing rescues.
Construct tactical climbing lanes.
Conduct steep earth climbing.
Conduct cliff reconnaissance reporting.
Conduct cliff assault.
Extricate personnel from a tree.

d. Summer Mountain Leader (SML). This Marine is qualified as an Assault Climber and can additionally do the following:

Plan and conduct tactical operations in mountainous terrain.
Conduct short roping techniques on rock and ice.
Care and maintenance of snow / ice equipment.
Conduct glacier travel.
Conduct crevasse rescue.
Know mountain health considerations.

All of the special skills can be obtained at the Marine Corps Mountain Warfare Training Center (MCMWTC) in Bridgeport, CA. Training as an Assault Climber or TRST can be obtained at 1st and 2nd SOTG. The ITSs for these special skills are listed and described in MCO 1510.87A. With the exception of qualification as a Military Mountaineer, all skills require sustainment training in order to maintain currency. Contact any of the schoolhouses for current requirements.

1003. Training

A major factor for success in mountainous operations is physical endurance. The rugged terrain, increased load requirements and the increased altitude all combine to increase the demands on the Marines' stamina. The battalion should implement a progressive hike program prior to deployment to a mountainous area. If the Marines are in shape, injuries will be minimized and the Marines will focus on the training and not on themselves. Training areas should approximate the ruggedness of the planned area of operation. If

possible, deployment to MCMWTC is the best means for initially training the unit for a mountain campaign because it has a cadre of instructors and a Program of Instruction (POI) focused on training Marines and Sailors how to survive, move, and fight in the mountains. Individuals who will receive special skills training should be carefully selected personnel, who have good physical endurance, athletic ability, and a strong work ethic. When feasible, the training period should be long enough to enable the Marines to acquire the necessary skills, to practice them, and to become thoroughly conditioned to the mountain environment. Another consideration is whether the battalion must prepare for winter as well as summer operations. Training should be continuous, vigorous and as difficult as conditions permit for best results. At a minimum, the training should encompass the following:

Mountain walking and route selection.
Rope management
Use, care, and preservation of rope and mountaineering equipment.
Fixed rope installations.*
Proper packing of gear in rucksacks.
Climbing.*
Rappelling*.
Mountain medevac techniques.*
Mountainous navigation.
Communications in the mountains.
Mountain safety and health awareness.
Techniques of fire in the mountains.

*Covered in *Military Mountaineering.*
All other areas will be covered later in this book.

1004. Leadership

The consequences of poor leadership in a temperate climate are significant; however, the consequences of poor leadership in a mountainous environment will be multiplied as a result of extreme weather and terrain. Not only must pre-environmental training take place before a unit can be expected to succeed in the mountains, but positive leadership and adherence to Core Values must be ever present in order to sustain the unit.

a. Environment. Just the words "mountain warfare training" can cause anxiety in a Marine unfamiliar with the environment. The psychological adjustment of the individual Marine to the mountain environment is extremely important. Many persons who have lived at low altitudes all their lives may have preconceived notions about the supposedly harmful effects of high altitude on the human organism. To them, any abnormal complaints, however trivial, may be construed as an ill effect of altitude. Such individuals become unduly concerned about their physical condition. This can be prevented by an active educational campaign showing that high altitudes do not have many of the supposedly harmful effects and that adjustment is largely a matter of time and conditioning. Frequently, personnel transported from flat terrain approach steep slopes or

cliffs with inner qualms and a sense of insecurity. If they are slowly introduced to them, their confidence will progressively develop until they can negotiate a passage across such obstacles with assurance and ease. Men should be taught various handholds and footholds, indoctrinated in the principles of mountain walking, and familiarized with pitfalls to be avoided. Most Marines, while varying in their proficiency, will at least learn to function adequately after a reasonable amount of exposure to mountain training. The conduct of field exercises in mountainous conditions will increase the Marine's confidence in his ability to survive and fight in the once unfamiliar environment.

b. Physical Conditioning. Regardless of previous training and the amount of flat cross-country marching practiced, the Marine newly introduced to mountain marching finds it arduous and tiring. A new group of muscles is developed and hardened. Furthermore, a new technique of moving rhythmically is required. This conditioning is attained only through daily marches and climbs which result in increased stamina and endurance. At altitudes above approximately 8000 feet, time must be allowed for the red blood count to increase to augment the oxygen carrying capabilities of the blood. Simultaneously with this development, men acquire increasing self-confidence in their ability to safely negotiate terrain that they previously considered impassable.

c. Lead by Example. Initially, harsh and unfamiliar conditions tend to be frightening and pose new challenges to Marine leaders. Junior Marines will automatically look to their leaders when conditions become harsh. If Marine leaders are visible and maintain a positive attitude, subordinates are more likely to follow their example.

d. Inspections. Personnel inspections must become routine within a unit. Incorrect or unserviceable equipment can have devastating effects; in the course of conducting inspections, the leadership not only gains confidence that the unit is properly outfitted, but also demonstrates to the Marines that their leadership is concerned with their welfare.

e. Time. Every task in the mountains can take longer than in a less rugged environment: waking up in the morning, preparing food, striking bivouac, and movement. Leaders cannot set unrealistic time-standards for task accomplishment.

1005. Combat Leadership

In combat operations, additional considerations for leadership need to be considered. Fostering a climate of acceptance of independent action down to the fire team level will yield overall company success. Encouraging and rewarding initiative in subordinates to take charge of the situation will create the proper mentality for mountain operations. Most of the time, small units will be out of visual and/or verbal contact with higher because of the terrain. It is likely that in such a situation, action against the enemy will have to be taken by the small unit leader; that is not the time for them to hesitate and second-guess themselves. During training, present your small unit leaders with situations and have them react. Positively critique their reaction and have them explain the reason for their action. This will not only develop the subordinates skills, it will give the leader

an idea of what to expect from the subordinate in a real situation. The leader should also practice giving mission type orders to his Marines and develop his commander's intent. This helps build the implicit understanding between the leader and his subordinates, so that they might know what he expects and how they should act in the absence direct orders.

1006. Mountain Safety

The key to safety in a mountainous environment is proper planning. Adhering to certain basic principles and predetermined actions will allow an individual or unit to efficiently perform their duties with minimum discomfort and maximum safety.

a. Planning and Preparation. As in any military operation, planning and preparation constitute the keys to success. The following principles will help the leader conduct safe and efficient operation in any type of mountainous environment. These principles can be easily remembered by using the acronym "BE SAFE MARINE". Remember to think about what each letter means and apply it in any type of environment.

B- ***Be aware of the group's ability***. It is essential that you evaluate the individual abilities of your Marines and use this as the basis for planning. In your evaluation, you must consider your group's overall physical conditioning, the change in climate and how long the unit has had to acclimatize. Following are some considerations:

- Mental attitude of your group. Is their morale high? How much tactical training has the group had in this particular type of terrain?
- Technical aspect of your group. Have they had prior training in rope work, mountaineering, rappelling, stream crossing, etc.?
- Individual Skills. At this point, you must choose who is the most proficient at the individual skills that will be needed for the accomplishment of your mission (navigation, call for fire, bivouac site selection, rope installations, etc.) Just as in the leadership principles, the better you know your Marines and how they have been trained, the more effective you will be in any environment, especially a mountainous one.

E- ***Evaluate terrain and weather constantly***.

- Terrain. During the planning stages of your mission, you must absorb as much information as possible on the surrounding terrain and key terrain features in your area of operation. Considerations for any obstacles must be planned for in advance. Will you need such things as fixed ropes, rope bridges, climbing gear, etc?
- Weather. Mountain weather can be severe and rapidly changing. Drastic weather changes can occur in the space of a few hours with the onset of violent storms, reduced visibility, and extreme changes. In addition to obtaining current weather data, the leader must have a plan for the unexpected "worst case". During an operation, he must continually evaluate weather signs (See paragraph 2004. Mountain Weather) to be able to foresee possible

weather changes. Being aware of the changes and trends will better prepare you to deal with any dangers it may pose. Remember, in most elevations over 8000 feet it can snow any month of year. Constantly evaluate the conditions. Under certain conditions it may be advisable to reevaluate your capabilities. Pushing ahead with a closed mind could spell disaster for the mission and the unit.

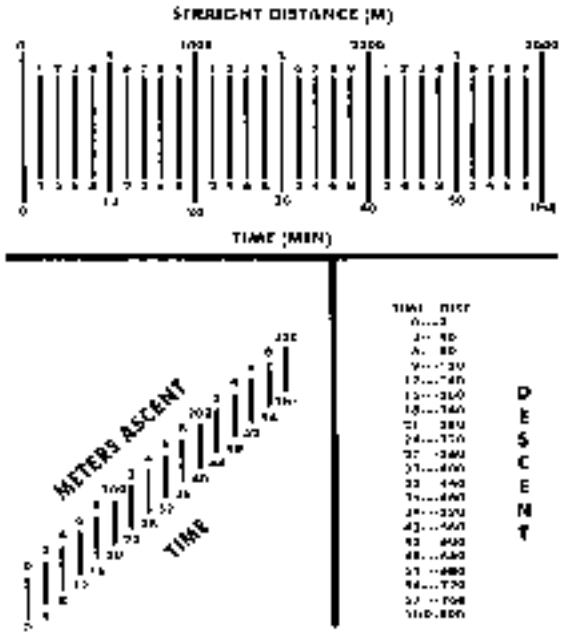
When in a lightning storm, turn off all radios, stage radios and weapons away from personnel. Have personnel separate, preferably in low-lying areas, however personnel should not sit underneath a lone tree. Being aware of these two factors will play a key role in keeping your unit healthy and operational.

S- ***Stay as a group***. Individuals acting on their own are at a great disadvantage in this environment.

- Maintain a steady pace so that it will allow the unit to reach the objective area as a complete fighting force.
- Give the unit adequate rest halts. Consider the terrain and elevation, physical abilities of the unit, combat load and mission requirements.
- Remember to use the buddy system in your group.

A- ***Appreciate time requirements***. Efficient use of available time is vital. The leader must make an accurate estimate of the time required for his operation based on terrain, weather, unit size, abilities, and on the enemy situation. This estimate must take into account the possibility of unexpected emergencies and allow sufficient time to make unplanned bivouacs in severe weather conditions.

Time-Distance Formula. This formula is designed to serve as a guideline. It is a good basis to start from in order to get an estimate for the amount of time required for your movement in ideal conditions.



Example: A patrol going 5000 meters straight line would need 1 hour and 40 minutes. If during that patrol they will also climb two hills, one 100 meters high and the second 200 meters high, then add 20 minutes and 40 minutes. If the patrol will descend those two hills and drops down into a 100 meter ravine, add 30 minutes for a total patrol time of an estimated 3 hours and 10 minutes. (Straight line distance time + total elevation gain time + total elevation descent time = total time)

Route planning. Route cards are not to be used in the place of an overlay, but as a tool to be used in route planning. Overlays/ Route cards should contain the following information at the minimum:

Unit designation
Unit commander
Number of personnel
Inclusive dates and times of movement
Grid coordinates of each checkpoint and bivouac
Map references
Azimuth and distances for each leg
Elevation gain/ loss per leg
Description of the ground
ETA and EDT.

Unit I.D.	Unit Cdr	Number of Personnel	Date and Time	Map Reference

LEG	AZM	DIST	GRID	ETA	ETD	ELEV. GAIN/ LOSS	DESC. OF GRND

As in any military operation, route planning and execution are of vital importance. Prior to departure, the unit commander must submit a route card and patrol overlay to his higher headquarters, and keep a duplicate copy for himself. This pre-planned route should be followed as closely as possible, taking into account changes based on the tactical situation. In non-tactical situations, the pre-planned route should be followed to reduce search and rescue time in an emergency situation.

F- ***Find shelter before storms if required.*** Under certain conditions, inclement weather can provide tactical advantages to the thinking unit commander, but it can also reduce the efficiency of the unit if an incorrect evaluation of the situation is made.

- If there is a drastic change in the weather, shelter should be sought. Medical problems due to the elements can manifest themselves in a matter of hours resulting in death.
- Locating or building a natural or man-made shelter will give an individual the best chance to have a safe bivouac with the prospect of continuing the effort toward mission accomplishment later. Exposure to the environment can kill or incapacitate more of your Marines than the enemy, if you allow it to.

E- ***Eat plenty of food and drink lots of liquids***.
Food. The human body can be compared to a furnace, which runs on food to produce energy and warmth. By planning the consumption of food to suit the specific situation, adequate nutrition and extra warmth can be supplied.
Water. The intake of adequate amounts of water will maintain the body in proper working order. Danger from dehydration is as high in mountain regions, due to the drier air, as in hot, dry areas. Loss of liquids is easily seen and felt in hot climates, whereas in the cold mountains, the loss of body fluids is much less noticeable, but just as prevalent. Increase water intake to at least 6 quarts per day when in bivouac, 8 quarts per day when active, will help to prevent dehydration.

M- ***Maintain proper clothing and equipment.***
Clothing. Our clothing has to perform an important function in our mission. Therefore, we must properly care for it. Often you will be issued a cold weather clothing system (3001. Personal Equipment) for deployment to the mountains.

Equipment. Lives will literally hang on the equipment you use. Therefore, it is extremely important that qualified individuals (MLs, ACs, TRSTs) regularly and properly inspect the equipment for wear.

- Required load requirements (see Annex A). An assault load should always be carried and one safety pack should be carried per squad for any operation away from the bivouac.
- As many Marines as possible should carry map and compass.
- A repair kit should also be carried to include those items necessary to do emergency repairs on your equipment such as a heavy-duty needle and nylon thread, extra fastex buckles, snaps and buttons.

A- ***Ask locals about conditions***. An often-overlooked source of information is the indigenous population of an area. Local weather patterns, rockslide areas, watering points, and normal routes can all be obtained by careful questioning. The leader must try to obtain current information on the actual conditions along your intended route. Of particular importance are recent precipitation and enemy sightings.

R- ***Remember to keep calm and think*****.** If faced with an emergency situation, the following principles should be used:

- Keep calm and do not panic. At this point you must make every effort to conserve body heat and energy.
- Think. When you are cold, tired, hungry, or frightened, you must force yourself to organize your thoughts into a logical sequence.
- Teamwork. Above all else, the group must act as a team. In emergency situations, individual dissention can cause a total loss of control and unit strength.

I- ***Insist on emergency rations and kits***. Survival rations and a survival kit should always be carried.

N- ***Never forget accident / emergency procedures***.
Causes of accidents. Accidents are no different in a mountainous environment than in a more benign environment, but several basic points should always be kept in mind. The most frequent causes of accidents are as follows:

- Overestimation of physical and technical abilities.
- Carelessness.
- General lack of awareness of ones surroundings.
- Leaders lack of knowledge and experience.
- The failure to act as a team.
- Underestimation of time requirements to move through mountainous terrain or underestimation of the terrain itself.
- Preventive measures. The only truly effective preventive measures for the above issues lie in the education and experience of leaders and Marines at all levels. Only through an active education and involvement can a leader of Marines gain the knowledge and experience needed to effectively lead in this environment.

General procedures for handling an accident. These procedures require only common sense as outlined below.

- Perform basic first aid.
- Protect the patient from the elements to include insulation on top and bottom.
- Evacuate if necessary.
- Send for help if required; if possible, never send one man alone for help.
- Send the following information regarding the accident:
  Time of accident
  Nature and location of accident.
  Number injured.
  Best approach route to accident scene.
- Buddy Teams. If one man of a two-man team is injured, the injured man must be given all available aid prior to going for help. If the injured man is unconscious, he should be placed in all available clothing and sleeping gear and anchored down if on steep terrain. A note explaining the circumstances, and a reassurance to him that help is on the way should be left in a conspicuous spot. This note must also contain the following information:
  When you expect to return.
  Where you went.
  What you did before you left (medication, etc.)
- Signals.
  International distress signal:
  Six short blasts in one minute from person requesting help.
  The return signal is three blasts in one minute from the responder.
- Other methods if help is required:
  Red pyrotechnics.
  SOS(. . . - - - . . .).
  "Mayday" by voice communications.

E- ***Energy is saved when warm and dry***. With the previous 11 principles in mind, this one should fall right into place. Save heat and energy by following these steps:

- Dress Properly
- Eat Properly
- Drink Properly
- Ensure shelter meets criteria.
- Produce external heat (fire, stove, extra clothing, etc.) to save body heat and energy for future use.
- Do not lose body heat by getting wet.

Staying combat effective in the mountains requires more vigilance on the parts of Marines and leaders than in a more temperate environment. By following the previous guidelines you can overcome or prevent most self-inflicted difficulties. As a leader it is one of your responsibilities to educate your Marines on these issues.

1007. Mountain Health Awareness

a. General. High mountain environments are inherently dangerous. They can be unforgiving for those without adequate knowledge, training, and equipment. Commanders, Marines, and medical personnel must understand that the interaction of environmental conditions with mission responsibilities and individual and unit characteristics can significantly impact on the outcome of the mission. Adequate planning and preparedness can reduce or prevent adverse impacts.

The ideal condition for Marines operating in high mountain terrain is to be in a high degree of acclimatization, since this achieves maximum physical and mental performance and minimizes the incidence of altitude illness. However, operational scenarios often limit the proper time needed to achieve acclimatization.

All Marines should be aware of the threats associated with operations in high altitudes and use personal protective measures in order to minimize disease and non-battle injuries, which in turn results in mission accomplishment. Personnel with active medical problems may bring problems upon others as well as themselves. Preexisting orthopedic injuries will often worsen under the increased stress of movement through the mountains. Individuals in poor physical condition are often more likely to suffer orthopedic or traumatic injuries requiring time and manpower intensive casualty evacuations (CASEVACs). The increased incidence of injuries that occur in the mountains is going to deplete the availability of medical personnel. All Marines should be able to recognize and initiate treatment of medical conditions ranging from trauma to environmental injury. All personnel should be familiar with the litters and methods used to evacuate casualties over steep terrain.

ALTITUDE	FEET	EFFECTS OF ALTITUDE
Low	Sea Level - 5,000	None
Moderate	5,000 - 8,000	Mild, temporary altitude illness may occur
High	8,000 - 14,000	Altitude illness and decreased performance is increasingly common
Very High	14,000 - 18,000	Altitude illness and decreased performance is the rule
Extreme	18,000 - higher	With acclimatization, humans can function for short periods of time

Medical Terms

AMS	Acute mountain sickness
Apnea	Temporary pause of breathing
Edema	A local or general condition in which the body tissues contain an excessive amount of tissue fluid
HACE	High altitude cerebral edema (brain edema)
HAPE	High altitude pulmonary edema (lung edema)
Hypobaric-hypoxia	Decreased availability of oxygen in ambient (surrounding) air
Hypoxia	Low oxygen content; decreased concentration of oxygen in inhaled air

b. The Body's Response to High Altitude. Hypobaric-hypoxia lowers the oxygen supply to the body, which in turn causes altitude illnesses and reduced physical and mental performance. Hypobaric-hypoxia may also increase the likelihood of other environmental injuries (e.g., cold) or worsen preexisting medical conditions.

Altitude acclimatization allows Marines to achieve the maximum physical work performance possible for the altitude to which they are acclimatized. Once acquired, acclimatization is maintained as long as the Marine remains at altitude, but is lost upon return to lower elevations. Exposure to higher altitudes requires further acclimatization.

For most Marines at high to very high altitudes, 70-80% of the respiratory component of acclimatization occurs in 7-10 days**;** 80-90% of overall acclimatization is generally accomplished by 21-30 days. Maximum acclimatization may take months to years. Note: there does not seem to be any way to speed acclimatization; some Marines acclimatize more rapidly than others do; and few Marines may not acclimatize at all. There is no reliable way to identify Marines who cannot acclimatize except by their individual experience during previous altitude exposures.

c. Acclimatization.
Graded Ascent. Limits the daily net altitude gain to allow partial acclimatization. The body needs time to ascend to acclimate to higher altitude. Ascend at a moderate rate, averaging 1,000 feet a day in net elevation gain.

If carrying heavy loads, it may be necessary to establish bivouacs at 2,000-foot intervals so that loads can be carried one day and the bivouac moved the next, for a net gain of 2,000 feet every *two* days. If suitable bivouacs are 3,000 feet apart, carry most of the load the first day, move the bivouac the next, and rest the third day, for a net gain of 3,000 feet every *three* days. Schedule rest days after rigorous climbing.

An old mountaineering maxim, "Climb high, sleep low" has been proven medically sound. The body acclimates much faster during exertion than during rest, and recovers more quickly at a lower altitude.

At extreme altitude, most people begin to deteriorate physically regardless of acclimatization. Minimize the stays at extreme altitudes and periodically return to lower altitudes to recover.

d. High Altitude Illnesses.
* IMPORTANT NOTE! The preferred step in treating any high altitude illness is to evacuate the Marine to a lower altitude.

(1) Acute Mountain Sickness (AMS) is caused by rapid ascent (altitude gain in 24 hours or less) to high altitudes. Symptoms include headache, nausea, vomiting, fatigue, irritability, and dizziness, and appear 3 to 24 hours after ascent. Everyone is susceptible. AMS is rare below 6,500 ft.

AMS can be prevented by a graded ascent or movement to a lower altitude. Consuming carbohydrates (whole grains, vegetables, peas and beans, potatoes, fruits, honey, and refined sugar) can reduce AMS symptoms.

In situations where there is insufficient time for a graded ascent, Marines may have to use medications to prevent AMS. Diamox, the preferred medication for preventing AMS, will prevent symptoms in nearly all Marines and reduce symptoms in most others. Use of any medication, including diamox, decadron, and nifidipine should be discussed with physicians trained in high-altitude/wilderness medicine. These medications are not standard in the AMAL of medical supplies for an infantry battalion, and need to be specially requested.

AMS symptoms will normally subside in 3-7 days if Marines do not continue to ascend. Once symptoms are resolved, Marines can resume gradual ascent. Marines who continue to show signs of AMS must be observed for development of HAPE or HACE, both of which are potentially fatal.

(2) High Altitude Pulmonary Edema (HAPE) occurs when unacclimatized individuals rapidly ascend to high altitudes or when acclimatized Marines ascend rapidly from a high to a higher altitude. Untreated, HAPE can be rapidly fatal and is the most common cause of death among the altitude illnesses. Marines experiencing AMS who are not treated and continue to ascend to higher altitudes are at significant risk for HAPE.

HAPE usually begins within the first two to four days after rapid ascent to altitudes greater than 8,000 ft (rare below 10,000 ft) and generally appears during the second night of sleep at high altitude. Symptoms include coughing, noisy breathing, wheezing, gurgling in the airway, difficulty breathing, and deteriorated mental status (confusion, vivid hallucinations). Ultimately coma and death will occur without treatment.

Countermeasures for HAPE include: proper acclimatization; sleeping at the lowest altitude possible; avoiding cold exposures; and avoiding strenuous exertion until acclimatized. Immediate descent is recommended as the best treatment for HAPE. Marines with AMS should be monitored carefully since AMS can rapidly evolve to HAPE.

(3) High Altitude Cerebral Edema (HACE) is the most severe illness associated with high altitudes. Individuals with HACE are frequently found to also have HAPE. As with other high altitude illnesses, HACE is caused by rapid ascent to high elevations without proper acclimatization. Marines with AMS who continue ascent are considered to be at high risk for development of HACE. Like HAPE, HACE is rare below 10,000 ft.

HACE generally occurs later than AMS or HAPE. Untreated, HACE can progress to death over one to three days and, in some instances, in less than 12 hours. Symptoms often resemble AMS (severe headache, nausea, vomiting), however, a more dramatic signal that HACE may be developing is when the upper body sways, especially when walking. Early mental changes may include confusion, disorientation, and drowsiness.

Marines may appear to be withdrawn or demonstrate behavior generally associated with fatigue or anxiety.

Countermeasures for HACE include: following countermeasures for AMS and HAPE (acclimatization, etc.); immediate evacuation (descent) for Marines with HACE symptoms. Again, Marines with AMS or HAPE should be monitored carefully for signs of HACE.

A Gamow bag is recommended when operations may occur above 14,000 ft. Gamow bags are portable hyperbaric chambers used in the treatment of HACE or HAPE. They may be obtained from civilian medical suppliers.

Under no circumstances should Marines with severe AMS symptoms or suspected HAPE or HACE be allowed to continue ascent.

(4) Subacute Mountain Sickness occurs in some Marines during prolonged deployments (weeks/months) to elevations above 12,000 ft. Symptoms include sleep disturbance, loss of appetite, weight loss, and fatigue. This condition reflects a failure to acclimatize adequately.

(5) Poor wound healing may occur at higher elevations resulting from lowered immune functions. Injuries resulting from burns, cuts, or other injuries may require descent for effective treatment and healing.

e. Environmental Threats. Conditions that are not unique to high mountain environments but commonly occur at high elevations include:

(1) Cold Injuries. Once a Marine has acclimatized to altitude, cold injuries are generally the greatest threat. Frequent winds in mountain areas cause extremely low wind-chill. Because hypoxia-induced psychological effects can result in poor judgment and decision-making, a higher incidence of cold injuries should be anticipated.

Countermeasures for cold injuries include command emphasis in: maintaining nutrition, drinking plenty of fluids; and dressing in layers.

(2) Injuries Caused by Sunlight. The potential for solar radiation injuries, caused by sunlight, is significant at high altitudes due to increased ultraviolet (UV) radiation (resulting from thinner atmosphere), and reflection of light from snow and rock surfaces. Solar radiation injuries can be severe and occur with much shorter exposure at high altitude. Injuries include sunburn and snow blindness.

(3) Sunburn may be more likely to occur on partly cloudy or overcast days when Marines may not be aware of the threat and do not take appropriate precautions. Some medications can also increase the threat of injury, including diamox. Application of sunblock (at least 15 SPF) to exposed skin, face, and neck will help prevent instances of sunburn.

(4) Snow blindness results from UV-light absorption by the external parts of the eyes, such as the eyelids and cornea. There is no sensation, other than brightness, as a warning that eye damage is occurring with resulting sunburn-like damage occurring in a few hours. Sunglasses or goggles with UV protection will prevent snow blindness. Sunglasses with side protectors are recommended.

(5) Terrain Injuries. Marines should be aware of the dangers of high altitude including avalanches and falls. Poor judgment at high altitude increases the risk of injury. The potential for being struck by lightning is also increased at higher altitudes, especially at areas above tree lines. Protective measures include taking shelter in solid-roofed structures or vehicles, staying low, and avoiding tall structures or large metal objects.

(6) Carbon Monoxide (CO) Poisoning is a frequent hazard and is caused by the inefficient fuel combustion resulting from the low oxygen content of air and higher usage of stoves, combustion heaters, and engines in enclosed, poorly ventilated spaces. Cigarette smoking is another source of CO. Countermeasures to prevent CO poisoning include ensuring Marines do not: sleep in vehicles with engines running; cook inside tents or sleep inside tents with working combustion heaters or stoves without adequate ventilation.

(7) Non-Battle Injuries. Hypoxia and cold can impair judgment and physical performance resulting in a greater risk of injury while maneuvering in rugged terrain. Heavy clothing worn for protection against the cold and specialized equipment can also restrict movement. Non-battle injuries can be prevented by carefully observing safety procedures.

(8) Infectious Diseases. Although there is generally a reduced threat of disease at higher elevations, Marines should still take precautions to avoid diseases caused by insects, plants, and animals, and diseases transmitted person-to-person.

At moderate to high altitudes, insect-borne disease (from mosquitoes, ticks and flies) is common in most regions. In some areas, malaria-bearing mosquitoes range as high as 6,000 ft. The threat of diseases transmitted from person-to-person is increased at higher, cold climates since Marines are more likely to gather together to keep warm.

f. Altitude Effects on Mountain Operations.

(1) Reduced Physical Performance. Hypobaric hypoxia causes a reduction in physical performance of Marines deployed to high altitudes. Marines cannot maintain the same physical performance at high altitude that they can at low altitude, regardless of their fitness level and acclimatization.

Countermeasures to prevent disease and injury include ensuring acclimatization; adjusting work rates and load carriage; planning frequent rests during work and exercise; and planning and performing physical training programs to altitude.

(2) Psychological Effects. Altitude exposure may result in changes in senses (vision, taste, etc.), mood, and personality. These effects are directly related to altitude and are common at over 10,000 ft. Some effects occur early and are temporary while others may persist after acclimatization or even for a period of time after descent.

Vision is generally the sense most affected by altitude exposure. Dark adaptation is significantly reduced, affecting Marines as low as 8,000 ft**.** and can potentially affect military operations at high altitude.

Mental effects most noticeable at very high and extreme altitudes include decreased perception, memory, judgment, and attention. To compensate for loss of functional ability, Marines should devise a strategy of a tradeoff between speed and accuracy -- allow for extra time to accomplish a task to minimize errors (and injuries).

Alterations in mood and personality traits are common during high-altitude exposures.
· Within hours of ascent, many Marines may experience euphoria, (joy, excitement) which is likely to be accompanied by errors in judgment leading to mistakes and accidents. Use of the buddy system during this early exposure time helps to identify Marines who may be more severely affected.
· After a period of about 6-12 hours, euphoria decreases, often changing to varying degrees of depression. Marines may become irritable, or may appear listless.

Instilling a high morale and esprit de corps before deployment and reinforcing these frequently during deployment will help minimize the impact of negative mood changes.

(3) Sleep Disturbances. High altitude has significant harmful effects on sleep. The most prominent effects are frequent periods of apnea and fragmented sleep. Sleep disturbances may last for weeks at elevations less than 18,000 ft and may never stop at higher elevations.

Reports of "not being able to sleep" and "awake half the night" are common and may also contribute to mood changes and daytime drowsiness. These effects have been reported at elevations as low as 5,000 feet and are very common at higher altitudes.

Diamox has been found to improve sleep quality at high altitudes as well as the added benefit of reducing AMS and other altitude illnesses. Sleeping pills and other medications that promote sleep or drowsiness should be taken only with medical supervision.

(4) Dehydration is a very common condition in Marines at high altitude. Causes include perspiration/sweating, vomiting, and hypoxia-induced diminishing of thirst sensation. Routine activities and chores performed at high altitudes require increased exertion. Even common activities, like walking, cause increased exertion, causing increased perspiration, and contributing to hot or cold weather injuries.

Dehydration increases the likelihood of operationally significant problems including cold injuries and decreased physical abilities. Note: Many symptoms of dehydration and HACE are similar.

Water discipline. Strict control is exercised over all sources of water supply. Troops cannot assume that any mountain water is safe for consumption. Water discipline is emphasized since the water demand of an individual in the mountains is great, and unless closely controlled, he may drink polluted water. All water must be filtered, boiled or treated with chemicals. Fluids are lost through respiration, perspiration, and urination. This loss must be replaced if the individual is to operate with normal efficiency.

Marines can prevent dehydration by consuming three to four quarts of water or other non-caffeinated fluids (or more) per day. Thirst is not an adequate warning of dehydration. Keeping the color of urine clear is the best way to ensure proper hydration. Commanders must monitor Marines to ensure they drink enough fluids and do not become dehydrated as a result of diminished judgment or the desire to avoid latrines.

(5) Nutrition. Poor nutrition contributes to illness or injury, decreased performance, poor morale, and susceptibility to cold injuries and can severely impact military operations. Influences at high elevations that impact nutrition include a dulled taste sensation (making food undesirable), nausea, or lack of energy or motivation to prepare or eat meals. Poor eating habits may also lead to constipation or aggravation of hemorrhoids.

Marines can reduce the effects of poor nutrition at high elevations by increasing the quantity of and eating all components of meals. Rations should be supplemented and frequent snacking encouraged. High carbohydrate snacks are recommended since they are easily carried by Marines and require no preparation.

Marines must be encouraged to have regular bowel movements in order to prevent stomach cramps and more dangerous illnesses. Ensuring that their diet includes fiber will help. Also having a latrine sheltered from the elements and providing some privacy will keep Marines from avoiding its use.

Other products that can seriously impact military operations include tobacco, alcoholic beverages, and caffeine.

Tobacco smoke interferes with oxygen delivery by reducing blood oxygen-carrying capacity; tobacco smoke in close, confined spaces increases the amounts of CO, and the irritant effect of tobacco smoke may produce a narrowing of airways interfering with optimal air movement. Smoking can effectively raise the "physiological altitude" as much as several thousand feet.

Alcohol impairs judgment and perception, depresses respiration, causes dehydration, and increases susceptibility to cold injury.

Caffeine from coffee and other sources may improve physical and mental performance; however, it also causes increased urination (leading to dehydration) and therefore, should be consumed in moderation.

(6) Personal Hygiene. The principles of personal hygiene and sanitation that govern the operations of troops in the lowlands are applicable in the mountains as well. The air is relatively germ-free above 14,000 feet; however, mountains of lower altitudes are in the same category as lowlands insofar as sanitary practices are concerned.

Under extreme conditions of cold, there is a general tendency for the individual to permit himself to become constipated in order to avoid the inconvenience and discomfort of straddling a trench in the cold. This neglect should be discouraged by all officers and noncommissioned officers (NCOS) of a unit since it ultimately induces illness.

Personal cleanliness is especially important in extreme cold. In freezing temperatures, individuals tend to neglect washing because of the cold and the scarcity of water. This may result in skin infections and vermin infestation. When bathing is impossible for any extended length of time, the individual should at least examine his skin and stimulate and cleanse it as much as possible by briskly rubbing his body with a rough towel paying particular attention to the feet and anal areas. In this way, the occurrence of skin infections may be kept at a minimum.

Care of the Feet. An infantryman's feet are often his only mode of transportation in the mountains. As a result, blisters and foot injuries will often occur. These can be prevented to a high degree by wearing proper footwear and by dealing with "hot spots" as soon as possible before they develop into blisters. Particular attention is devoted to the care of the feet to protect against trench foot and frostbite. The causative conditions f or one or the other of these disturbances are prevalent throughout the entire year in high mountains. The feet must be kept dry and socks and innersoles changed at least twice daily (4 times per day if wearing Vapor Barrier (VB) boots). For a more detailed discussion of trench foot and frostbite, see MCRP 3-35.1A, *Small Unit Leader's Guide to Cold Weather Operations.*

Chapter 2. Environmental Characteristics

2001. Mountains

Mountains are landmasses that rise above the surrounding terrain by at least 1000 feet. They may be composed of exaggerated terrain features and compartments. Slopes in the mountains generally vary from 4 to 30 degrees with cliffs and/or precipices that may be vertical or even overhanging. The terrain displays the resistant qualities of the rocks from which they were formed with ridges, canyons, cliffs, caves, and valleys as evidence of the process of erosion. Mountain belts are landmasses that may be up to hundreds of miles wide and thousands of miles long consisting of peaks, plateaus, valleys and other major terrain features. The Rocky Mountains and the Appalachian Range are examples of mountain belts. Within mountain belts are mountain ranges. Mountain ranges may be tens of miles wide and hundreds of miles long consisting of a series of peaks linked by ridges, passes and elevated terrain. The Catskill and Adirondack Mountains of the Appalachian Range and the Karakoram of the Himalayas are examples of mountain ranges. Finally, within mountain ranges are individual peaks that may tower significantly over their surroundings to include other peaks and encompass tens to hundreds of square miles at their base. Mount Whitney of the Sierra Nevada and K2 of the Karakoram are examples of mountain peaks.

2002. Glaciers

Glaciers are rivers of ice moving slowly down a mountain. They are found year round and are formed when the rate of snowfall/precipitation exceeds the rate of thaw/melting in the warm season. After an accumulation over hundreds of years, the snow is compressed into ice that may be tens to several hundred feet thick. Glaciers may be small, covering only one portion of a mountain or they may be massive with a series of glaciers covering a mountain range. Glaciers cover approximately 10% of the Earth's landmass. While glaciers can be found on the equator (e.g. Andes Mountains in South America above 16,000 feet), they are generally more common in the northern latitudes. At approximately 40 degrees north, glaciers can be found at 10,000 feet and even further north (or south) at 60 degrees, they run down to the sea. Glaciers can be difficult terrain to move across. The lower portions of the glacier or transition zone from ice to water, is known as the ablation zone. This area will have exposed ice, deep and/or wide (ten to hundred feet) crevasses or cracks and seracs or icefalls to mention just a few obstacles. Therefore, travel will require special equipment and training to move across a glacier. With the proper training and equipment, what the enemy, may perceive as an impossible obstacle, may be an unguarded avenue of approach. (See Chapter 9, MCRP 3-35.2B, *Military Mountaineering*)

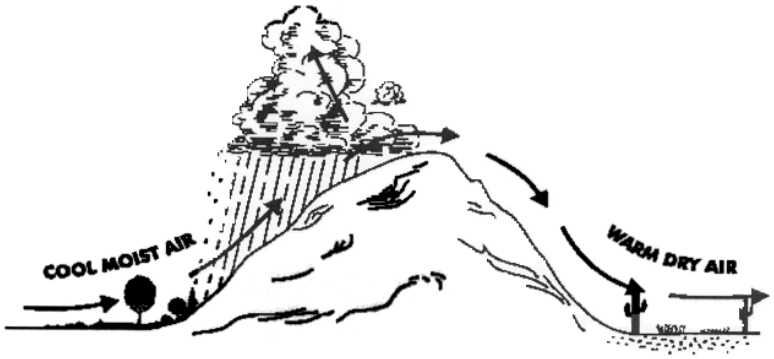
2003. Climate and Vegetation

Climate and vegetation varies with the geographical location of the mountains and with changes in the elevation and aspect of the mountain itself. In those areas where the mountain heights reach into areas of year-round snow, climatic conditions approach those found in the forests of Polar Regions. In the low latitudes (0-15 degrees), the zone of permanent snow appears above 12,000 feet. Snow lines and timberlines occur at high elevations near the equator and occur at progressively lower elevations as they approach the poles. Operations in these areas are planned to specifically cope with the conditions of snow and extreme cold. For a detailed discussion of cold weather operations see MCWP 3-35.1 *Cold Weather Operations*, and MCRP 3-35.1A *Small Unit Leader's Guide To Cold Weather Operation.* Temperature limits the altitude at which various types of vegetation will survive. As altitude increases, temperature drops at the rate of about 3° F/1000 ft, and vegetation decreases in both variety and quantity.

2004. Mountain Weather

Normally, as Marines from temperate climates, we often consider bad weather as affording us a tactical advantage, providing concealment in order to move undetected. But in a mountainous environment, bad weather can have a devastating effect on your own troops if not properly prepared. It is crucial that you be able to understand the fundamentals of meteorology and determine what to expect from incoming weather patterns. While this section will not make you an expert, it will help you in the evaluation of your environment and recognize when a potentially dangerous situation may be arising.

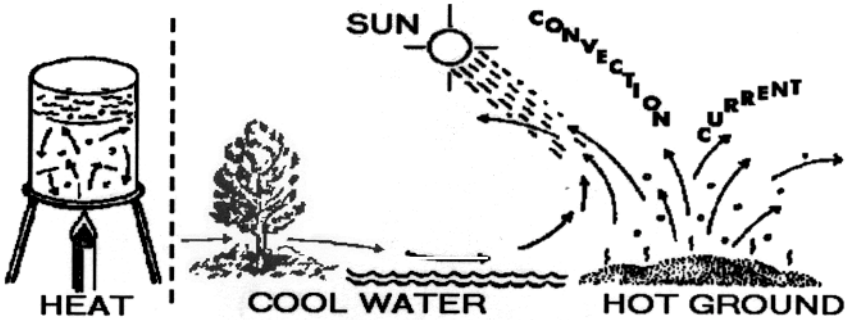
a. Lifting and Cooling: Air can only hold so much moisture according to its temperature. If air is cooled beyond its saturation point, it must release the extra moisture in one form or another, i.e. rain, snow, fog, etc. There are three ways that air can be lifted and cooled beyond its saturation point.



OROGRAPHIC UPLIFT

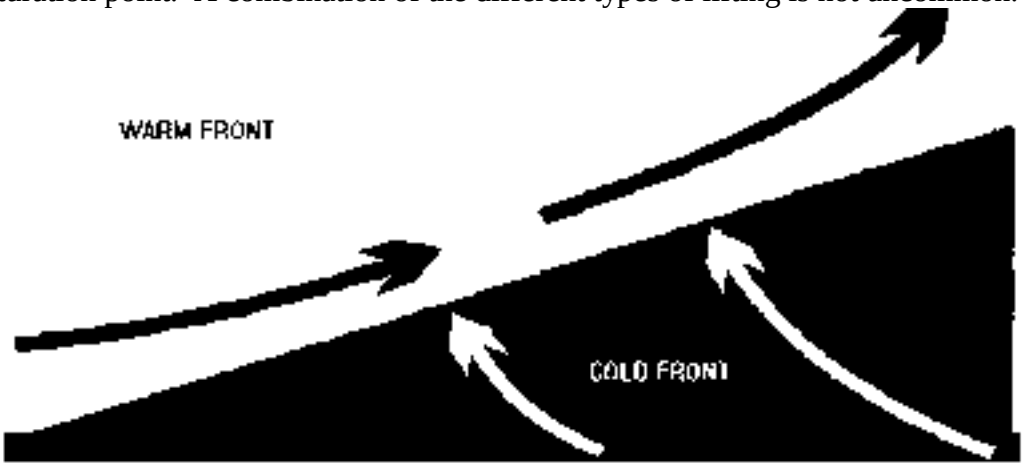
Orographic Uplift. This happens when an air mass is pushed up and over a mass of higher ground such as a mountain. Due to the adiabatic lapse rate, the air cools with increasing altitude and if it reaches its saturation point, the result is precipitation. This is the method that we will be the most concerned with in a mountainous environment.

Convection Effects. This is normally a summer effect due to the sun's heat re-radiating off of the surface and causing the air currents to push straight up and lift air to its saturation point.



CONVECTION EFFECTS

Frontal lifting. When two air masses of different temperature and moisture content collide, there is a front. Since the air masses will not mix, the warmer air is forced aloft; from there it is cooled until it reaches its saturation point. A combination of the different types of lifting is not uncommon.



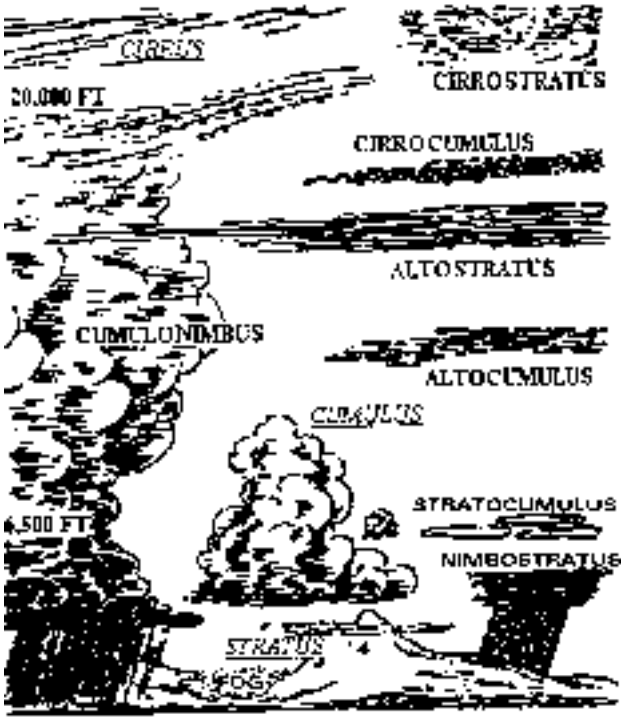
FRONTAL LIFTING

b. Clouds: Any time air is lifted or cooled beyond its saturation point (100% relative humidity), clouds are formed. Clouds are one of our signposts to what is happening. Clouds can be described and classified by height or appearance, or even by the amount of area covered, vertically or horizontally.

Cirrus. These clouds are formed of ice crystals at very high altitudes (usually 20,000 to 35,000 feet) in the mid-latitudes and are thin, feathery type clouds. These clouds can give you up to 24 hours warning of approaching bad weather, hundreds of miles in advance of a warm front. Frail, scattered types, such as "mare tails" or dense cirrus layers are a sign of fair weather but predict a prelude to approaching lower clouds, the arrival of precipitation and a front.

Cumulus. These clouds are formed from rising air currents and are prevalent in unstable air that favors vertical development. These currents of air create cumiliform clouds that

give them a piled or bunched up appearance, looking similar to cotton balls. Within the cumulus family there are three different types to help us to forecast the weather:



-Cumulus are fair weather clouds but should be observed for possible growth into towering cumulus and cumulonimbus.
-Towering Cumulus is characterized by vertical development. Their vertical lifting is caused by some type of lifting action, such as convective currents found on hot summer afternoons or when wind is forced to rise up the slope of a mountain or possibly the lifting action that may be present in a frontal system. The towering cumulus has a puffy "cauliflower-shaped" appearance.
-Cumulonimbus clouds are characterized in the same manner as the towering cumulus, forming the familiar "thunderhead" and produce thunderstorm activity. These clouds are characterized by violent updrafts, which carry the tops of the clouds to extreme elevations. Tornadoes, hail, and severe rainstorms are all products of this type of cloud. At the top of the cloud, a flat anvil shaped form appears as the thunderstorm begins to dissipate.

Stratus. Stratus clouds are formed when a layer of moist air is cooled below its saturation point. Stratiform clouds lie mostly in horizontal layers or sheets, resisting vertical development. The word "stratus" is derived from the Latin word for "layer". The stratus cloud is quite uniform and resembles fog. It has a fairly uniform base and a dull, gray appearance. Stratus clouds make the sky appear heavy and will occasionally produce fine drizzle or very light snow with fog. However, because there is little or no vertical movement in the stratus clouds, they usually do not produce precipitation in the form of heavy rain or snow.

As previously stated, clouds are formed when air is lifted to a point where it cools to its saturation point. We also know that frontal lifting affects our fronts, which produce the largest portion of our precipitation.

c. Fronts. Fronts often happen when two air masses of different moisture and temperature content interact. One of the ways we can identify that this is happening is by the progression of the clouds.

Warm Front. A warm front occurs when warm air moves into and over a slower (or stationary) cold air mass. Since warm air is less dense, it will rise naturally so that it will push the cooler air down and rise above it. The cloud you see at this stage is cirrus. From

the point where it actually starts rising, you will see stratus. As it continues to rise, this warm air, cooled by the cold air, receives moisture at the same time. As it builds in moisture, it darkens becoming "nimbus-stratus", which means rain or thunderclouds. At that point some type of moisture will generally fall.

Cold Front. A cold front occurs when a cold air mass (colder than the ground that it is traveling over) overtakes a warm air mass that is stationary or moving slowly. This cold air, being denser, will go underneath the warm air, pushing it higher. Of course, no one can see this "air", but one can see clouds and the clouds themselves can tell us what is happening. The cloud progression to look for is cirrus to cirrocumulus to cumulus and, finally to cumulonimbus.

Occluded Front. Cold fronts move faster than warm ones so that eventually a cold front overtakes a warm one and the warm air becomes progressively lifted from the surface. The zone of division between cold air ahead and cold air behind is called a "cold occlusion". If the air behind the front is warmer than ahead, it is a warm occlusion. Most land areas experience more occlusions than other types of fronts. In the progression of clouds leading to fronts, orographic uplift can play part in deceiving you of the actual type of front, i.e. progression of clouds leading to a warm front with orographic cumulus clouds added to these. The progression of clouds in an occlusion is a combination of both progressions from a warm and a cold front.

d. Using Pressure as an indicator. A very important factor of telling us what might happen is the pressure. Low pressure or dropping pressure normally indicates deteriorating weather whereas high pressure usually gives us more good weather or clearing of bad weather. There are a couple of ways to monitor the pressure.

The Barometer. A barometer could be described as a pan of mercury with a tube leading out of the pan. Pressure from the atmosphere causes the mercury to rise in the tube. The tube is marked in millibars and the station that's reading these millibars will know how much it should rise for that location. Once again, if it rises more than normal, it would be considered a high-pressure reading.

The Altimeter. Another means that is used to measure pressure is an altimeter, which is commonly used by mountaineers. It works as follows:
As you gain elevation the atmospheric pressure decreases, causing the needle in the altimeter to rise. If the you notice that the needle slightly rises over a few hours while you stay at a fixed elevation, there is a low-pressure area moving in, which can be an indicator of bad weather to come.

Contrail Lines. A basic way of identifying a low-pressure area is to note the contrail lines from jet aircraft. If they do not dissipate within two hours, that indicates a low-pressure area in your area. This usually occurs about 24 hours prior to an oncoming front.

Lenticulars. These are lens-shaped cumulus clouds that have been sculpted by the winds. This indicates moisture in the air and high winds at high altitude. When preceding a cold front, winds and clouds will begin to lower.

e. Using signs from nature. These signs will give you a general prediction of the incoming weather conditions. Try to use as many signs together as possible, which will improve your prediction. All of these signs have been tested with relative accuracy, but should not be depended on 100%. But in any case you will be right more times than wrong in predicting the weather. From this we can gather as much information as needed and compile it along with our own experience of the area we are working in to help us form an educated guess of incoming weather. The signs are as follows:

- A spider's habits are very good indicators of what weather conditions will be within the next few hours. When the day is to be fair and relatively windless, they will spin long filaments over which they scout persistently. When precipitation is imminent, they shorten and tighten their snares and drowse in the centers.
- Biting insects are especially aggressive two to four hours before a storm.
- If bees are swarming, fair weather will continue for at least the next half day.
- Large game such as deer, elk, etc., will be feeding unusually heavy four to six hours before a storm.
- When the smoke from a campfire beats downward after lifting a short distance with the heated air, a storm is approaching. Steadily rising smoke indicates fair weather.
- "Red sky at night is a sailor's delight; red sky in the morning is a sailor's warning." This poem is correct in only some places of the world. When the sun rises in the morning and there is moisture present, the sky will be red. If the wind is moving west to east, that moisture has already past. This does not mean that it will not rain; it just means that the moisture making the sky red is already past. When the sun sets in the west, and there is moisture in the sky, the sunset will be red. If the winds are moving west to east, it means that the moisture in the west making the sky red will move east and possibly form as clouds later.
- A gray, overcast evening sky indicates that moisture carrying dust particles in the atmosphere have become overloaded with water; this condition favors rain.
- Gray morning sky indicates dry air above the haze caused by the collecting of moisture on the dust in the lower atmosphere; you can have a reasonably fair day.
- A rainbow in the late afternoon indicates fair weather ahead. However, a rainbow in the morning is a sign of prolonged bad weather.
- A corona is the circle that appears around the sun or the moon. When this circle grows larger, it indicates that the drops of water in the atmosphere are evaporating and the weather will probably be clear. When this circle shrinks by the hour, it indicates that the water drops in the atmosphere are becoming larger, forming into clouds and rain is almost sure to fall.
- In fair weather, air currents flow down streams and hillsides in the early morning and start drifting back up towards sunset. Any reversal of these directions warns of a nearing storm.

- It is unusually quiet before a storm because wildlife are generally inactive immediately prior to a storm.
- In the mountains, mist rising from ravines in the morning is a good sign of clear weather the rest of the day.
- A heavy dew or frost in the morning is a sign of fair weather for the rest of the day. This is due to the moisture in the atmosphere settling on the ground vice in the form of precipitation such as rain, snow, etc.

Chapter 3. Personal Equipment

3001. Cold Weather Clothing

a. Military cold weather clothing systems. Often a unit will get issued the cold weather clothing system for deployment to a mountainous environment. Military cold weather clothing systems are designed to change with needs of the Marines. By varying the parts of the clothing system they are using, Marines can be comfortable when performing vigorous activities in the cold if proper "principles of wear" are adhered to. The basic principles of wear can be remembered by using the acronym **C.O.L.D.**

C- Keep clothing CLEAN. Clothing keeps you warm by trapping warm air against your body and in the pores of the clothing itself. If these pores become filled with dirt, sweat, or other grime, the clothing will not be able to do its job efficiently. Therefore, your clothes should be kept as clean as possible to keep you as warm as possible.

O- Avoid OVERHEATING. Everyone naturally assumes that the more clothes you have on, the warmer you will be. This is true up to a point, and that point is when your body starts overheating and sweating. A Marine engaged in physical activity, such as digging a fighting position or snow shelter, will be warmer than one who is just standing guard. If both Marines are dressed the same, the one that is active will start to overheat. The key to surviving under this condition is not to be hot or cold, but *comfortably cool*. If at any time you are sweating, you are too hot. Sweating is a sign that your body wants and needs to cool down. Let the environment cool you down, not sweat. This may be as simple as opening buttons or unzipping the underarms of the ECWC parka, instead of removing a whole layer of clothing. Once you stop your work, or feel yourself getting cold, bundle up again just enough to keep cool. Allowing just enough clothes and body activity to keep you comfortably cool, and the environment to cool you down, will keep your clothes from getting sweaty and dirty, therefore improving their effectiveness. Overheating also contributes to several cold weather injuries such as dehydration, heat exhaustion, and hypothermia.

L- Wear clothing LOOSE and LAYERED. Loose Clothing- Clothes should fit loosely for comfort. If clothing is too tight, it may act as a tourniquet, causing blood to pool in your extremities, (arms, legs, fingers, and toes.) This prevents blood from circulating into your body core and re-warming, thus causing that limb to get cold. Tight clothing will also prevent air from becoming trapped between your body and clothes. It is the warm air that keeps you warm, not the clothes.

Layering- Compare this to your house, which has several layers, not just one, to keep you warm. It has shingles and a roof, a wood frame, siding, insulation, walls, foundation, and floor. A furnace heats the air inside the house to keep you warm. The layers are barriers holding this heated air around you. The first wall holds a

warm cushion of air, perhaps allowing 25% of the warm air to escape. The second wall or insulation, however, will capture part of that, holding another warm layer of air, until only a fraction of warm air escapes to the outside. Even when a strong wind hits your house blowing away one layer of air, you still have several others. Your body works along the same principle, with your body being the furnace and your clothing layers being the walls. The more layers used, the more warm air will be trapped. Strangely enough, several thin layers working together will work better than one thick layer alone.

D- Keep clothing DRY. Clothing must be kept dry from the outside, such as putting on rain gear during wet conditions, and from the inside, such as taking a layer off when you start to sweat. Once your clothes are wet, the water or sweat starts to evaporate, drawing warmth away from your body.

a. Principles of Design. The principles of the military cold weather clothing systems are: Vapor Transmission Layer, Insulating Layer, and the Protective Layer. They are best remembered by using the acronym V.I.P. Moisture accumulated in the undergarments will inhibit the cold weather clothing systems from functioning correctly. A good rule of thumb is to *start cool.* Then after ten to fifteen minutes, make a rest stop, remove unnecessary layers and vent the neck, waist, and under the arms to avoid overheating.

Vapor Transmission Layer: Better called a "sweat transfer layer," this layer soaks up your body moisture and draws it away from your body to keep it dry. Significant progress has been made with such synthetics as polypropylene, which draws water away from the body, and helps to keep the body dry.

Insulating Layer: This is the layer that holds the warm air around your body. Preferably, it is made of polyester pile, but wool is adequate.

Protective layer: This not only protects the insulating layer from getting dirty, but also from getting wet. It should be made of a wind resistant/water repellent materials.

NOTE: These are the three main layers to consider in the military clothing system. There may be times when one or more layers are not used, or when the insulating layer may be several layers thick.

3002. ECWCS Clothing (NEW)

a. The Clothing Systems. There are three clothing systems currently in use in the Marine Corps: the new Extended Cold Weather Clothing System (ECWCS), the old M-1950 Cold Wet/Cold Dry seven layer system and the Specialty Clothing System developed to fit the specific needs of aviation and maintenance personnel (reference NAVAIR Manual 13-1-6.7 chapter 5.) This manual will only discuss the ECWS system since the old M-1950 seven-layer system is being phased out.

Extended Cold Weather Clothing System (ECWCS). ECWCS was developed to provide a lighter weight, less bulky clothing system that was better suited for the modern cold weather battlefield. This system uses recently developed synthetic materials to provide warmth and handle moisture much better than the older standard clothing system. ECWCS is a layered insulating system adjustable to personal preference, metabolism, and prevailing weather conditions. It is designed to maintain adequate environmental protection between 40° F and -25°F. In cold, wet, and arctic environments, it is recommended that Marines use only clothing items in the ECWCS. Marines should not combine ECWC garments with any items that are made with wool or wool blends, with the exception of the glove inserts and cold weather hood. It is easy to maintain in both field and garrison environments. The unique characteristics of this state of the art material require special use and care. You can find these instructions on the items themselves.

ECWCS Clothing Items

General. The Marine Corps has recently completed a new cold weather system.

Long Underwear. The cold weather system consists of the undershirt and drawers.

- Description of Undershirt. The polypropylene undershirt is a buff-colored turtleneck that has a center front zipper that extends to the middle of the chest area.
- Description of Drawers. The polypropylene drawers, also buff-colored, serve as a base layer to protects the lower extremities.
- Concept of Use. The underwear layer that is next to the skin acts as a vapor transmission or moisture wicking layer. This draws moisture away from the skin while transferring it to the outer layers of the clothing system. The wearing of issue cotton undergarments will negate the wicking action of the polypropylene. The cotton fibers will hold moisture next to the skin. Cotton equals death. DO NOT wear cotton undergarments when using this clothing.

Cold Weather Fleece Shirt. The cold weather fleece shirt is a new item. (Fleece Shirt/100% Polyester, 300 Weight)

- Description of Item. The shirt is black-colored, has reinforced shoulders, upper back, upper chest and elbow patches, a convertible turtleneck collar, front zipper, elastic shock-cord waist, Velcro fastened wrist straps, and two hand-warmer pockets with zippers.
- Concept of Use. The polyester fleece shirt serves as the primary insulating layer for the upper body.

Cold Weather Fleece Bib Overall. The cold weather fleece bib is a new item. (Fleece Bib/100%polyester, 300 Weight)

•Description of Item. The bib is black-colored, has adjustable elastic suspenders with quick release fastener buckles located in the front, front zipper, and full-length zippers at the outside seams.
•Concept of Use. The polyester fleece bib serves as the primary insulating layer for the lower body and legs. Recommended to be worn only when a Marine is stationary, i.e., standing sentry duty or in periods of intense cold.

Trousers, Cold Weather, Field, (Nylon and Cotton). The olive green or four-color camouflage printed cold weather field trousers, (Trousers, Cold Weather, Field, Nylon and Cotton), are standard items of cold weather issue and are also used in the ECWCS.

•Description of Item. Characteristics of the field trousers are the side-hanging pockets, hip pockets, cargo pockets, draw–cords at the trouser bottoms, and the adjustable waist straps.
•Concept of Use. The field trousers serve as a durable outer layer to be worn over the insulating layers when the outer extended cold weather trouser, (Gore-Tex), is not needed.

ECWCS Parka Camouflaged. (PARKA, extended Cold Weather, Camouflaged, Gore-Tex)

•Description of Item. The parka has an integral hood, (the new generation of parkas have a pocket in the collar for hood stowage), two inside breast pockets which can be accessible without unzipping the parka, two large cargo pockets, and a two-way front zipper to provide full face protection leaving only the eyes uncovered. There is an elastic draw cord at the hem, Velcro wrist tabs, underarm ventilation with zippers and a rank tab at center chest.
•Concept of Use. The parka serves as part of the windproof and water resistant layer in the system. The polytetraflouroethylene (PTFE) laminate in the garment serves to repel water while allowing perspiration to be expelled.

ECWCS Camouflage Trousers. (Trousers, Extended Cold Weather, Camouflage, Gore-Tex)

•Description of Item. The trousers have seat and knee reinforcement patches, pass through pockets, and inserts in the seams of the leg openings to allow easy donning and removal without removing the boots.
•Concept of Use. The trousers serve as part of the windproof and waterproof layer in the system. The PTFE laminate in the garment has the property to repel water while allowing perspiration to be expelled.

Snow Camouflage Parka and Trousers. The snow camouflage parka and trousers (Parka, Snow Camouflage and Trousers) are standard carryover items from the M-1950 issue.

•Description of Item. The hooded white parka has drawstrings for adjustment at the waist draw cord, side pockets, a hip pocket, knee pleats and drawstrings at the ankles of the trousers. The parka and trousers, snow camouflage, are to be worn for whatever type of camouflage is required in snow covered terrain.
•Concept of Use. The over white parka trousers are used as a camouflage outer layer in snow-covered terrain and is not a substitute for an outer garment. It is worn over the (ECWCS) parka and trousers.

Hood C/W (Balaclava). The head wear in the ECWCS cold weather system.

•Description of Item. The hood consists of a wool, knitted cap, which covers the entire neck and face with holes for the eyes and nose and is a pullover ski mask style that comes in either green or black.
•Concept of Use. The cap is intended to provide protection in cold weather to the neck and face.

Hand Wear.
•General. The standard hand wear items are: Glove inserts, gloves, mitten inserts, mitten shells (cold weather and snow camouflage mitten set). These items are carryover items from the standard M-1950 cold weather issue. These items are considered part of the ECWCS issue. The gloves and glove inserts are unit supply items, while the mittens, mittens inserts and camouflage shells are Training Allowance Pool items.

3003. ECWCS Accessories (NEW)

a. The items in this section are considered part of the ECWCS issue. Some of these items are new to the Marine Corps while some are carry over items from the M-1950 issue.

ECWCS Accessory Items

Suspenders. The suspenders (Suspenders, Trousers M-1950) are a carry over item used with the field trousers.

•Description of Item. The olive drab suspenders straps are scissor-back style (cross over in the back). The suspenders have two slide buckles and two hooks that attach to the trousers.
•Concept of Use. The suspenders are to be used with the trousers, extended cold weather, camouflage.

Head-over Scarf. The head-over scarf (Scarf, Head-over) is an item borrowed from NATO allies. This item enables Marines to regulate their body temperature.

•Description of Item. The head-over scarf is a circular knitted wool tube 2 feet long and 9 inches wide laid flat, open at both ends, with the face of the fabric lightly brushed.

•Concept of Use. The head-over scarf is to be wrapped around the neck, pulled over the head and ears, or pulled down over the neck and lower back.

3004. Care, Use, and Maintenance of ECWCS (NEW)

a. The individual Marine is responsible for keeping his ECWCS items in good serviceable condition. This is his uniform. It will not continue to effectively serve its intended purposes unless it is kept clean, maintained in good repair, and stored properly. The ECWCS will protect him only if he takes care of it and wears it properly. Check the label to see if the size is correct. This is extremely important in order to achieve maximum user satisfaction using the layering principle. ECWCS IS DIFFERENT. Pay particular attention to cleaning instruction for layers 1 and 4, polypropylene underwear and parka/trousers, extended cold weather, camouflage, as these items are made of state of the art materials and require added care.

b. Donning and Doffing Procedures. The ECWCS is an insulating system consisting of the following five primary layers (including the overwhites, when necessary) and accessories:

Layer1-Polypropylene undershirt and drawers

Layer2-Bib overall, cold weather shirt and trouser liner.

Layer3-Coat liner and field trousers.

Layer4-Extended cold weather camouflage parka and trousers.

Layer5-Snow camouflage parka and trousers (overwhite)

c. Layering. Layers 1 and 4 are always worn; add layers 2 and 3 as necessary to stay warm. The bib overalls in layer 2 are normally worn for temperatures below –25 °F. Remove layers 2 and 3 as necessary to avoid overheating when on the move. The polypropylene underwear has the ability to draw moisture away from the skin and transfer it to the outer layers of the system. Beginning with layer 1, add layers 2 and 3 as the temperature drops. Layer 4 is the outer layer of the ECWCS when snow camouflage is not required. Layer 5 is the outer layer of the ECWCS when snow camouflage is required. Layer 5 is not a substitute outer garment, but is worn over layer 4 only as a camouflage. Adjust layers according to preference, metabolism, and weather conditions.

d. Inspection. Examine the ECWCS items regularly for tears, punctures, or damage to the material. Punctures of the outer layer will produce leaks and eventually ruin the material if not properly maintained. Repairs should be made as soon as possible.

e. Rank Insignia. Attach rank insignia on the parka to the rank tab, which is provided at the center of the chest. Either the pin-on or sewn-on rank insignia may be used. Be careful not to puncture or snag the outer layer of the material when attaching rank as punctures will produce leaks.

f. Cleaning. Dirty clothes wear out quickly because dirt cuts textile fibers and retains moisture from perspiration. Prior to laundering and drying, make sure all the drawcords are tied together, all zippers are zipped and all snaps and hooks are fastened. Securing these items will result in a better-laundered garment. When laundering, use delicate or gentle fabric wash cycle or by hand, using cold water (up to 85° F) and cold water laundry detergent. Rinse in clean cold water. DO NOT USE BLEACH OR STARCH. Tumble dry at the lowest fabric cycle, delicate/gentle do not exceed 90° F. Remove immediately after drying. AVOID OVER DRYING. To drip dry, remove water and place or a rustproof hanger. **DO NOT PRESS**.

g. Water Repellency. If the fourth layer (Parka/Trousers, Extended Cold Weather, Camouflage) of ECWCS leaks and inspection has revealed no rips or tears, wash garments in mild powdered detergent. Detergents used in cleaning affect water repellent qualities. DO NOT WASH GARMENTS IN LIQUID DETERGENT. When liquid detergents are used, they leave a chemical residue, which actually reduces the waterproof properties of the fabric. To restore the weather repellency of the parka/trousers, occasionally steam garments with an iron on steam setting being careful to hold the iron about ½ inch above the garment. **REMEMBER, DO NOT PRESS**.

3005. Specialty Uniforms

The Specialty Uniform System uses four cold weather clothing layers found in the supply system and is not stored or obtained from the Training Allowance Pool, (TAP).

3006. Cold Weather Personal Equipment

Cold Weather Personal Equipment is specially designed to provide protection and to be as lightweight as possible.

a. The sleeping system consists of a sleeping bag, an insulated sleeping mat, and a waterproof bag. There are two types of sleeping bags that, when used in conjunction with the camouflage Gore-Tex bivy-bag, will provide protection according to the following temperature scales:

- **Sleeping Bag, Type I, intermediate cold**, for temperatures down to +10° F, uses polyester batting for insulation and weighs 7.5 lbs.

- **Sleeping Bag, Type II, extreme cold**, for temperatures down to –50° F, uses waterfowl feathers, down, and polyester batting for insulation, weighs 9.5 lbs.

Sleeping Mat. The sleeping mat replaced the old pneumatic mattress. It provides excellent insulation from ground cold and can be used for sitting, sentries, when consolidating following assaults, and in ambush positions when personnel must lie prone for long periods of time.

Waterproofing Bag. This is used to protect the sleeping bag from getting wet. Sleeping bags are difficult to dry once wet and care should be taken to keep them as dry as possible.

3007.Footwear

Mountaineering footwear will typically be the standard issue Marine Infantry Combat Boot made by Belleview. This is a good boot for climbing because it has a Vibram sole that grips well on the rocks. Also, the boot is thick and will help prevent injury to the foot when moving through loose rocks. Specialized footwear may be worn by the MLs and ACs. These include the climbing shoe and ice boot.

a. Climbing Shoe. This is a snug fitting, slipper type shoe that is worn for advanced rock climbing. It has a smooth, grippy rubber sole that conforms to the rock and allows the climber to practically stick to the cliff face. This may be used by the ACs and MLs if they are faced with a challenging cliff head that they must overcome and could not do so if wearing the combat boot. This is not an issued item and needs to be open purchased.

b. Ice Boot. This is an insulated plastic boot with a full length steel shank that will be worn by MLs when crampons need to be worn for an extended period of time, such as when climbing ice or crossing an icy glacier. Crampons are steel fang-like devices that are attached to the bottoms of boots. These boots are not an issued item and need to be open purchased.

3008. Pack Systems

Currently the Marine Corps issues the LCS-88 pack for use in the mountains. This pack has an internal frame, fully adjustable suspension, a map flap, three external ski tunnel pockets, an sleeping bag / main compartment divider, a radio pocket, and numerous attachment points for ALICE equipment. The MOLLE pack system is also currently being distributed to the operating forces and will eventually be the only pack system used by the Marine Corps. The rugged terrain and heavy loads take a toll on the serviceability of these packs. Marines should have their shoulder straps and waist belts resewn immediately if they are showing any signs of tearing. A pack will go out of action and have blow outs at the worst times, resulting in loss of equipment, loss of time fixing it or redistributing the load, and even injury. Packing of the pack will be covered in Annex A Warfighting Load Requirements.

Chapter 4 Mountaineering Equipment and Rope Management

4001. Marine Assault Climber's Kit (MACK).

a. Description. The Marine Assault Climber's Kit (MACK) is a comprehensive collection of climbing equipment that enables a Marine rifle company of approximately 200 Marines with organic equipment, to negotiate an average 300 foot vertical danger area. The kit contains sufficient climbing equipment to outfit four, two man climbing teams plus the additional items necessary to supply the remainder of the Rifle Company. The climbing teams use their equipment to conduct 2-party climbs over vertical obstacles and establish various rope installations to facilitate movement of the remainder of the company. The MACK will be used by Marines engaged in training and combat operations in mountainous areas having rugged terrain and steep slopes. Certain items contained in the MACK will also be used during training and combat operations in urban environments for scaling vertical obstacles such as buildings.

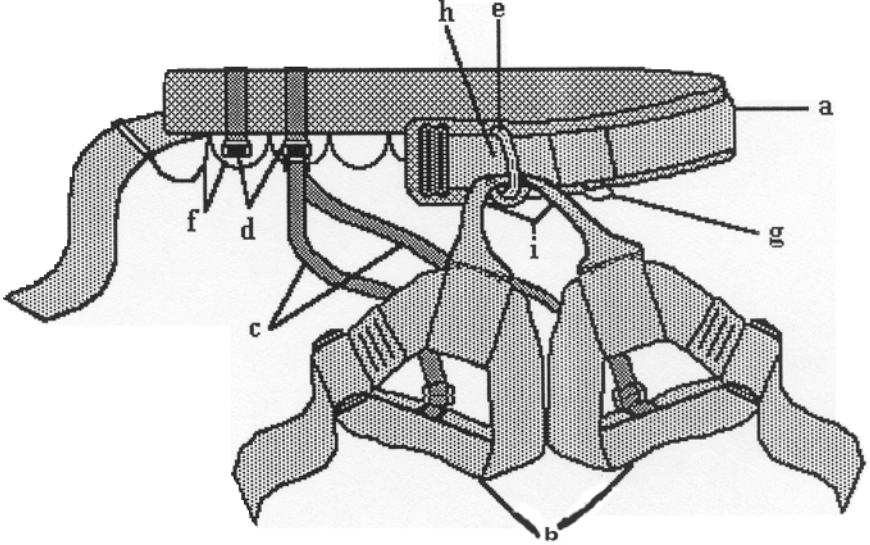
b. SL-3 Components. Four containers hold all the items contained in the MACK and have features that facilitate the organization and accountability of MACK items. Each container protects the contents from degradation due to sunlight and moisture during storage periods up to 5 years. The lid's interior has a permanently affixed list of the components and quantities stored within that container. Container #1 contains the climbing team equipment. Containers #2, #3, #4 contain the company climbing equipment. A manual for care/maintenance of SL-3 components is included with each MACK. See Annex B for the contents of the MACK.

c. Serviceability. Any item that becomes unserviceable or shows excessive signs of wear must be replaced immediately. With the exception of the rope bag and climbing rack bag, no attempt should be made to repair the components of the MACK. A damaged or broken component should be disposed of using standard supply procedures. Replenishment should be accomplished using the standard MILSTRIP process. Kit components not available through the MILSTRIP process may be purchased through local purchase.

d. Certified Users. Any Marine using components of the MACK must be supervised by a Marine who has received formal training as a Mountain Leader or Assault Climber. This training is provided by the Marine Corps Mountain Warfare Training Center's Summer Mountain Leader's Course and Assault Climber's Course or the Special Operations Training Group Assault Climber's Course. The school code, M7A for Mountain Leaders and YAK for Assault Climbers, will be on their BIR/BTR.

4002. MWTC Sit Harness.

This climbing harness will typically be available only for the MLs and ACs, however every Marine should be familiar with it. The number of climbing harnesses available



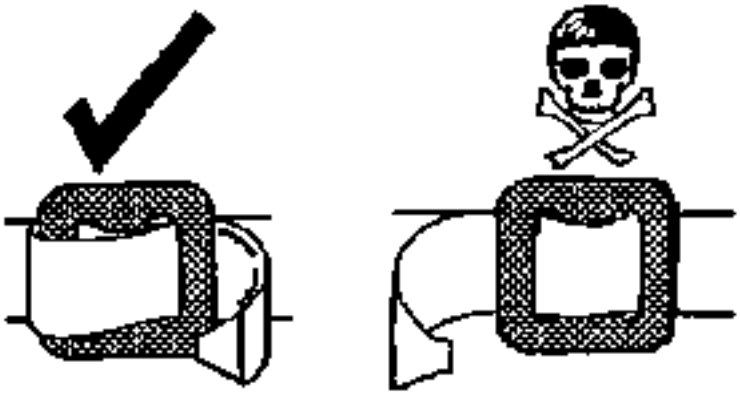
today is staggering. The Marine Corps, in co-operation with Yates Inc., has designed a climbing harness that can be used in a multitude of mountaineering operations, including two party climbing on rock or ice, rappelling, direct aid climbing, and many other techniques. It was one of the first harnesses made in the USA that passed the ANSI test and is rated to 5,950 lbs. tensile strength. It is also more comfortable than most harness as a result of the padded waist belt, and is a one size fits all.

a. Nomenclature.

(a) Waist Belt
(b) Leg Loops (adjustable)
(c) Buttocks straps (adjustable)
(d) Fastex buckle x 2
(e) Doughnut
(f) Equipment Loops
(g) D-Ring
(h) Waist Belt Tie-in Point
(i) Crotch Strap

b. Wearing of the Sit Harness.

First, disconnect the fastex buckle at the rear of the harness.
Hold the harness in front of you, put your feet through the leg loops, ensuring that the buckles are on the outside in your thighs.



- Thread the waist belt through the buckle, ensuring a tight but comfortable fit. **You must ensure that the waist belt is now threaded back through the buckle, this**

locks the waist belt into the buckle. Failure to do this will cause the waist belt to slip through under the load of a fall. Every year, more climbing injuries and deaths are caused by failing to do this than all other accidents.

- Adjust your leg loops so that they are high on your thighs, once you have them adjusted, get a buddy to clip the fastex buckle in the rear to one of the two adjoining buckles, which ever is more comfortable. Then adjust the buttocks strap so that the leg loops are held up. Once this is done the straps should be threaded back through the buckle in the same manner as the waist strap.
- When all of the above are done correctly, the harness should now be a comfortable but snug fit. After you have fitted it for the first time there is no need to go through the same procedures again each time you put the harness on. Only the waist belt needs to be undone and re-threaded properly for each use.

c. Tying Into the End of The Rope In A Sit Harness.
First begin with a retraceable figure of eight. Before you retrace the knot, pass the pigtail end of the climbing rope up under the crotch strap, then through the doughnut, and through the waist belt tie in point. Then continue to retrace the knot as taught. Adjust the knot to get it as close to the harness as possible with at least a fist of pigtail at the end.

d. Tying Into The Middle of the Rope In a Sit Harness. Take up a bight of approximately three feet and tie a figure of eight loop with the loop being approximately three feet. Then at the end of the loop tie another, smaller figure of eight loop. This excess will give the middle climber that amount of slack for freedom of movement. Then take a locking carabiner and attach it to the figure eight loop and hook into the harness by hooking the carabiner through the crotch strap, doughnut, and the waist belt tie in point.

4003. Ropes

a. Climbing Ropes.

- Kernmantle Static: Tensile Strength of 6,500 lbs.

  Uses: For all rope installations not involving top roping or two party climbing.

  Construction: Nylon kernmantle rope.

- Kernmantle Dynamic: Tensile strength of 5,400 lbs. The rope has a stretch factor for absorption of sudden shock, such as a fallen climber.
  Uses: For all types of lead/party climbing.
  Construction: Nylon kernmantle rope.
- 9mm Maxim Dry Rope: Tensile strength of 4,500 lbs.
  Uses: For glacier travel and ice climbing.
  Construction: Nylon Kernmantle treated with water a repellant/lubricant.
- Gold Line II: Tensile Strength of 4,500 lbs. (used at MCMWTC for miscellaneous training purposes).
  Uses: Sling ropes and for litters only.
  Construction: Eight strand braided nylon plymor.

NOTE: Sling ropes are made from 15 foot lengths of plymor or dynamic rope, *not static rope*. Twenty-five foot practice coils are either static or dynamic. Tensile strengths will vary with different manufacturers.

b. Advantages and Disadvantages. All comparisons are to the older Manila Rope.

Advantages of nylon rope.
High strength to weight ratio.
Good energy absorption in dynamic ropes.
Flexible.
Rot resistant, not affected by frost.
Disadvantages of nylon rope.
Low melting point. Nylon fuses at 400 degrees Fahrenheit and melts at 480 degrees Fahrenheit.
Susceptible to abrasions and cuts.
Affected by chemicals and light.

Advantages of Manila Rope.
Easily griped.
Hard wearing.
Does not deteriorate in heat.
Disadvantages of Manila Rope.
Heavy, kinks, especially when wet. Absorbs water and swells.
Burns at +300 degrees Fahrenheit.
Edible by rodents.

c. General Information
- Nylon rope stretches under tension and will rupture at between 30% and 70% elongation, depending on construction.
- Nylon rope loses as much as 30% strength when wet. After drying will lose 2 to 3% permanently.
- Temperatures as low as 250° Fahrenheit will damage a nylon rope.

4004. Nylon Webbing.

a. General. The type of nylon webbing available is tubular. Tubular nylon webbing is very strong and flexible. All rules that apply to nylon rope apply to nylon webbing. There are two types used.
- 1 inch tubular nylon. Tensile strength approximately 4,000-4,500 lbs. depending on the manufacturer.
- Pre-sewn spectra runners. Tensile strength approximately 5,500 lbs.

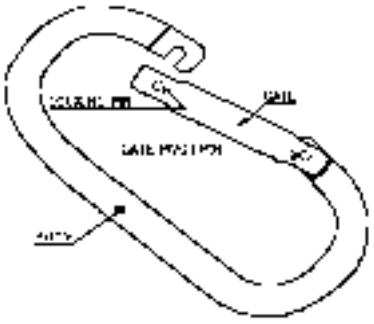
NOTE: These are minimum strengths. Some manufacturers make even stronger webbing. When knotted the breaking strength remains relatively the same as unknotted webbing.

4005. Carabiners.

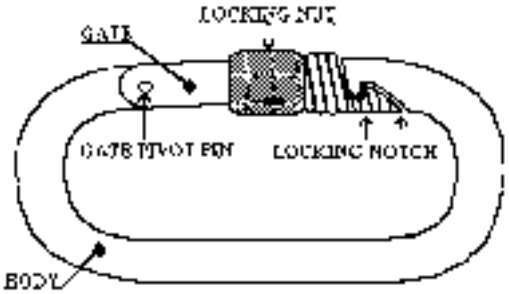
a. General. Commonly known as snaplinks. There are two types of carabiners frequently used in the Marine Corps: the steel locking carabiner and the aluminum non-locking carabiner.

Steel Locking. There are two different sizes of steel locking carabiners.
1) Steel locking Stubai 82: Tensile strength of 3,300 lbs.
2) Large Steel "D" locking Stubai 85: Tensile strength of 5,500 lbs.
Aluminum non-locking carabiners. The Omega standard D carabiner. Tensile strength of 4,400 lbs.

b. Nomenclature. There are four parts to a non-locking carabiner:
-Gate
-Gate Pivot Pin
-Locking Pin
-Body



There are five parts to a locking carabiner:
-Gate
-Gate Pivot Pin
-Locking Notch
-Locking Nut
-Body



STEEL LOCKING CARABINER

c. Care, Maintenance and Serviceability

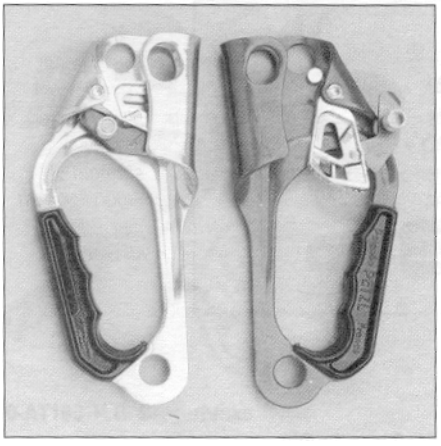
Care.
-Avoid dropping a carabiner on any hard surface, as hairline fractures can occur.
-Keep the carabiners off the ground. Dirt and grit can get into the working parts and damage the carabiner.
-If a carabiner has fallen off a cliff it should be retired and replaced.
Maintenance.
-Remove all dirt, moisture and grime.
-Lubricate with Tri-flow or similar graphite lubricant, and wipe off with a dry cloth.
Serviceability checks.
-The gate snaps shut with no friction and with no gap between the locking pin and the locking notch.
-There is no excessive side-to-side movement of the gate.
-The pivot pin is tight.
-The locking nut travels freely and locks securely.
-There are no cracks, bends or flaws.

NOTE: WHENEVER YOU USE A LOCKING CARABINER ENSURE THAT THE LOCKING NUT IS ALWAYS LOCKED DOWN!

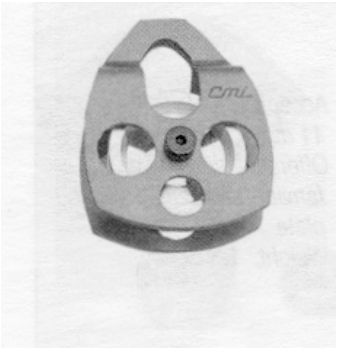
4006. Other Equipment Used in Mountaineering

a. General. Several more pieces of equipment that are used by the MLs and ACs are covered in greater detail in chapter 2 of MCRP 3-35.2B, *Military Mountaineering.*

b. Caving Ladder. Constructed of stainless steel cables and aluminum crossbars. Several ladders can be connected together, by the use of two large steel rings on each end of the ladder. (If rings are not present, clip carabiners into crossbars.)



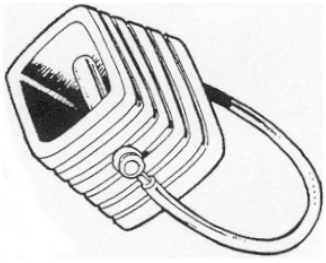
c. Ascenders. Easily placed and removed from a rope with one hand and allows the rope to run through it in one direction while it grips the rope and does not slide in the other direction. A safety device is incorporated to ensure that the cam only releases the rope when the trigger is pressed and out of position.



d. Rescue Pulleys. Have two independent side plates that enable a user to insert the rope onto the wheel without having to thread the rope through. The pulley is large enough to accommodate a ½ inch rope and has an eye large enough to accommodate two locking carabiners.

e. Figure Eight Descenders. Made of heat-dissipating aluminum alloy so the device stays cool after a rope has run through it. Care must be taken not to drop or bang these devices onto a hard surface or damage may occur. The figure eight's can be used as a belay and rappel device.

f. Belay Devices. These have several different names depending on manufacture. They may be stitch plates, belay slave, pyramid, or air traffic controller (ATC).



Left: Pyramid or ATC
Right: Stitch Plate

4007. Rope Management

a. Terminology

Bight. A simple bend in the rope in which the rope does not cross over itself

Loop. A simple bend in the rope in which the rope does cross itself

Half Hitch. A loop that runs around an object in such a manner as to bind on itself.

Running End. The free end of the rope that can be used.

Standing End. The part of the rope that is anchored and cannot be used, also called the static end.

Lay. The same as the twist of the rope. (Applies only to hawser laid ropes, such as manila.)

Pigtail. The short length left at the end of a rope after tying a knot or coiling a rope. It may or my not be tied off with a secondary knot, depending on the circumstances.

Stacking (or Flaking). Taking off one wrap at a time from a coil, and letting it fall naturally to the ground.

Dressing the knot. This involves the orientation of the entire knot parts so that they are properly aligned, straightened, or bundled and so the parts of the knot look like the accompanying pictures. Neglecting this can result in an additional 50% reduction in knot strength.

Setting the Knot. This involves tightening all parts of the knot so that all of the rope parts bind upon other parts of the knot so as to render it operational. A loosely tied knot can easily deform under strain and change character.

b. Care of the Rope

- The rope should not be stepped on or dragged on the ground unnecessarily. Small particles of dirt will be ground between the strands and wear the rope internally.

- The rope should never come in contact with sharp edges of any type. Nylon rope is easily cut, particularly when under tension. If a rope must be used around an edge which could cut it, then that edge must be padded or buffed using fire hose if available, or several small sticks.

- Keep the rope as dry as possible. If it should become wet, hang it in large loops, above the ground, and allow it to dry. A rope should never be dried out by an open flame or be hung to dry on metal pegs, as this will cause rust to get in the rope thus rendering it unserviceable.

- Never leave a rope knotted or tightly stretched longer than necessary.

- When using rope installations, never allow one rope to rub continually against another. **NOTE:** With manila ropes this will cause the rope to fray, whereas nylon ropes can melt under the friction that this causes.

- The rope should be inspected prior to each use for frayed or cut spots, mildew, rot or defects in construction.

- Mark all climbing ropes at their midpoints to facilitate establishing the midpoint for any procedure requiring you to use the middle of the rope. The rope should be marked with a bright colored adhesive tape.

- The rope should not be marked with paints or allowed to come in contact with oils or petroleum products for these products will weaken it.

- A climbing rope should ***NEVER*** be used for any other purpose except for mountaineering (i.e., towing vehicles).

- The ends of a new rope or ends caused by a cut should be cut with the rope cutter contained in the MACK and marked with a serial number.

- The rope should never be subjected to high heat or flame as this can significantly weaken it.

- Nylon ropes can be washed by using a mild soap and water solution, after which they should be rinsed thoroughly.

- When not in use, ropes should be coiled and hung on wooden pegs rather than on nails or any other metal object. They should be stored in a cool place out of the direct rays of the sun.

- When in areas of loose rock, the rope must be inspected frequently for cuts and abrasions.

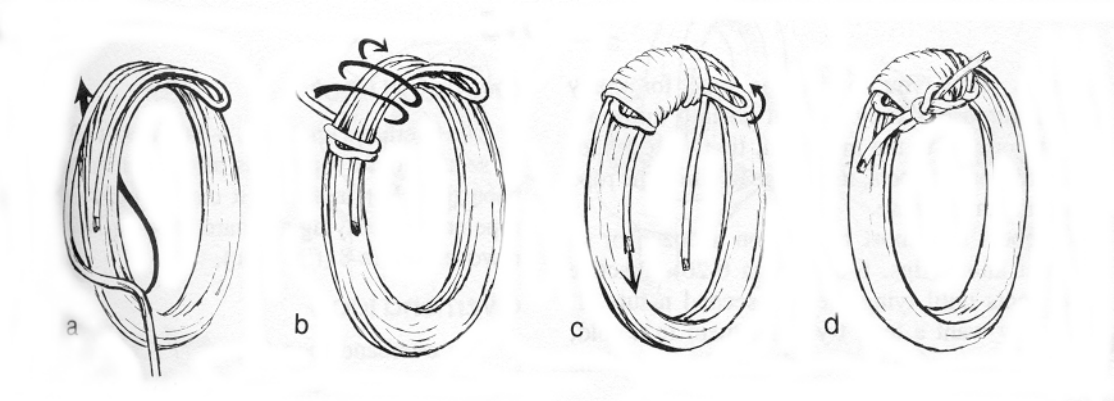
- Always maintain an accurate Rope Log whenever using a rope (discussed in chapter 2 of MCRP 3-35.2B, *Military Mountaineering.*)

4008. Coiling a Rope

There are two types of rope coils used. The Mountain Coil and the Butterfly Coil.

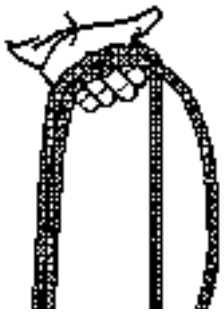
a. Mountain Coil. This coil is useful for carrying the rope over a pack or a climber's shoulder and neck. It can be used for a short time for storage also. The mountain coil can be tied in the following manner:
- The Leg Method. This is done with the assistance of another Marine.
One Marine sits down with his leg bent at a 90° angle, heel on the deck. Starting at one end, the rope is looped around the leg in a clockwise fashion, going over the knee and

under the boot sole until all but 2-3 feet is coiled. In finishing off the Mountain Coil, a bight approximately 12 inches long is formed with the starting end of the rope and laid along the top of the coil. Using the left over 2-3 feet begin making wraps around the coil and the bight, wrapping towards the closed end of the bight and making the first wrap bind upon itself so as to lock it in place. Four to six wraps should be made to secure the coil. The end of the rope is then pushed down through the closed end of the bight. The running end of the bight is then pulled tight to secure the coil. The two pigtails should now be joined with a square knot to prevent the wraps from uncoiling.
When coiling a 150 foot rope use only one leg to wrap the rope around. When coiling a 300 foot rope two legs should always be used to coil the rope and should be coiled in a mountain coil only.



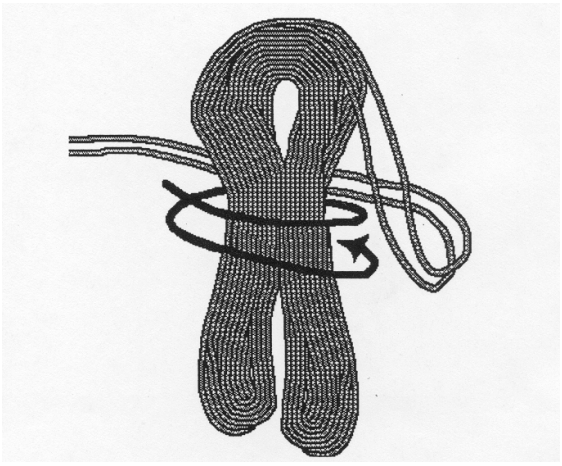
b. The Butterfly Coil. This method is used for carrying a rope when the individual needs to have maximum use of his upper body, (i.e. while climbing), without the encumbrance of a large rope coil hanging across his chest.

- Coiling the Butterfly Coil:



Step 1: Find the middle of the rope, then form a three foot bight laying both ropes in the upraised palm at the two foot point.

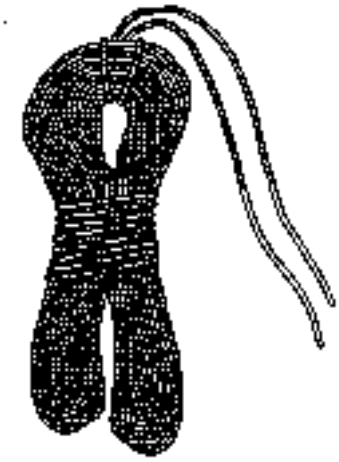
Step 2: Form another two foot bight with the running end. Place the rope at the two foot bight along side on top of the original bight ensuring the running end is on the same side as the original bight.



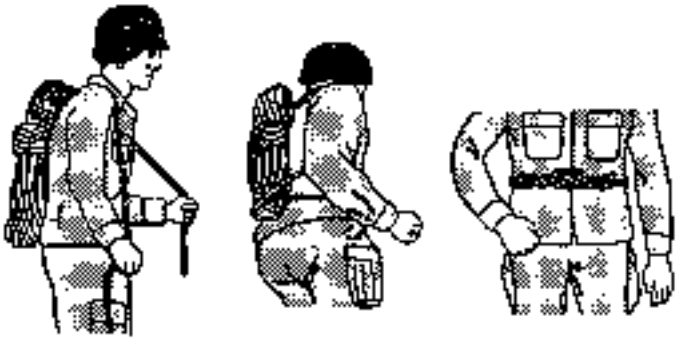
Step 3: Continue making two foot bights, laying them alternately into your palm until there are only six to eight feet remaining. At that point, begin wrapping the two pigtails horizontally four to six times at the midway point of the bighted ropes from bottom to top.

Step 4: After completing your wraps form a bight with the remaining pigtail and then thread it underneath your palm and upward to one foot above the coiled rope.

Step 5: With the remaining pigtail, thread it through the one foot bight formed in step four.



Carrying the Butterfly Coil. Separate the running ends, placing the coil in the center of the back carrier, then run the two ends over his shoulders so as to form shoulder straps. The running ends are then brought under the arms, crossed in the back over the coil, brought around the body of the carrier and tied off with a square knot at his stomach.



4009. Rope Throwing

a. Method. To insure that the rope will not get tangled when thrown, it will be necessary to carefully recoil the rope. This is done by stacking the rope, which is done by taking off one wrap at a time and letting it fall naturally to the ground. When the rope is flaked out, anchor off one end of the rope, then pick up the opposite end of the rope and make 6-8 coils in your left hand, and set them on the ground next to you. Pick up the remainder of the rope and begin making a second set of coils. You should now have two separate stacks of coils. Pick up the stack with the 6-8 coils and place it in your weak hand, the other stack of coils will go in your strong hand. There are two methods in which to throw the rope; underhand and overhand. The overhand method should be used when trees or shrubs or high winds are on or near the rappel point. Once the method of throwing has been determined, make a few preliminary swings with the strong arm (this arm holds the second set of coils) and shout "STANDBY FOR ROPE". Just before the rope leaves the hand shout the warning, "ROPE", which will alert anyone on the bottom, thus enabling personnel to move out of the way. As the coils are going down the cliff face you will feel a tug, at that time you will throw down the coils in your weak hand. Throwing the rope in this manner is the best way to ensure your rope will reach the bottom without snagging.

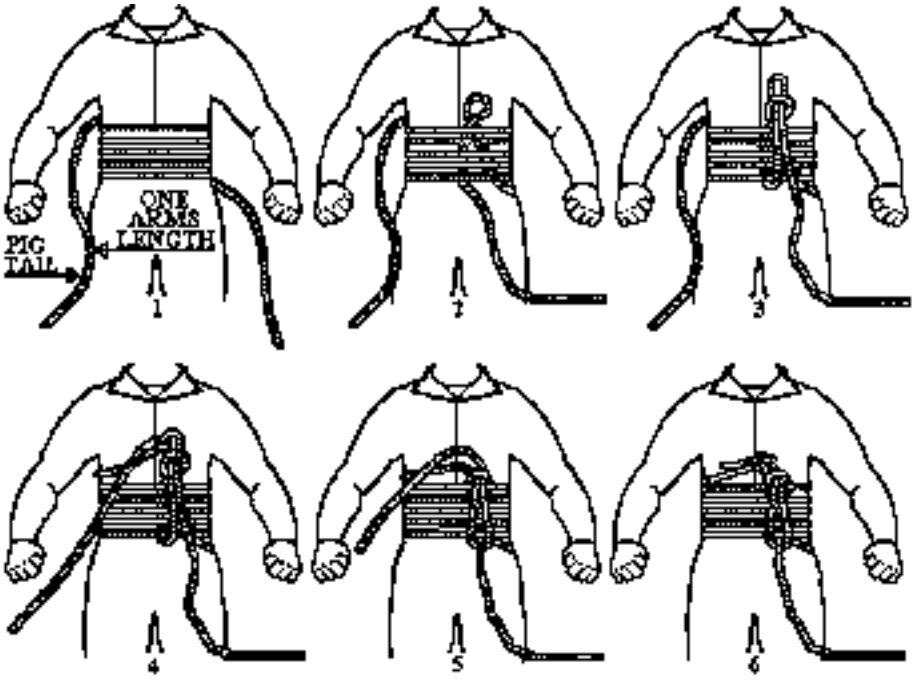
4010. Mountaineering Knots

The following are knots that every military mountaineer should know.

Square Knot. Used to tie the ends of two ropes of equal diameter together. It should be secured by overhand knots on both sides of the square knot. If the square knot and two over hands are going to be put under tension, run one end of the pigtail through the center of the square knot. Once the tension is released, pull the pigtail out. This procedure will aid you in untying the square knot. Since the knot was tightened down on the pigtail vice the knot itself.

Figure of Eight Loop. This knot forms a single bight and is used as an anchor in the middle or end of the rope. This knot also has a variety of different uses and situations ranging from fixed rope installations, securing a climber to his rope, secure a belay man in, and used in the safety lines for a one-rope bridge.

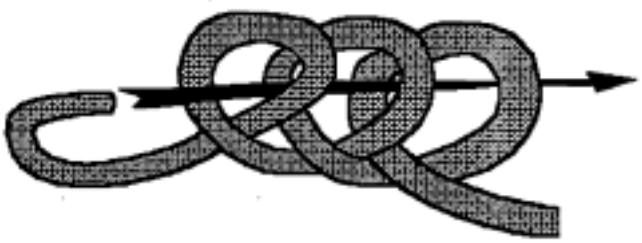
Bowline on a Coil. Used by the first and last men on a climbing rope to tie into the rope. An over hand knot is used behind the knot. It distributes the force of a fall over a larger area of a climber's waist and is preferable to a single bowline around the waist. The bowline on a coil can also be used to take up excessive rope. The bowline on a coil should have 4-6 wraps around the waist.



Overhand Knot. Used to make a knotted rope for a handline, a carrying rope for a suspension traverse, and in making the stirrups in direct aid climbing. This knot can also be used to temporarily whip the end of a rope and to secure other knots.

Knotted
Handline. This is used as a simple fixed rope for inexperienced or heavily laden troops. It's a series of overhand knots spaced 10-12 inches apart. It is constructed from a climbing rope as follows:

a) Grasp tail of rope in left hand palm down.

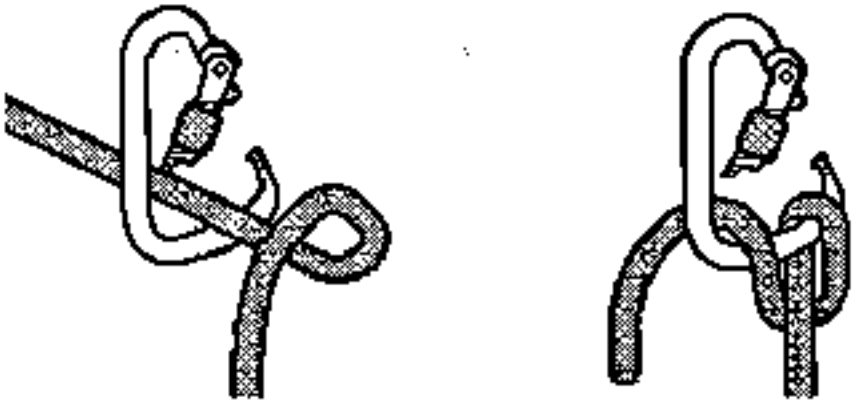


b) Make 5 inch diameter inboard loops outward in series of 5-8 loops. This will make approximately 10-12 inches between each knot.

Grasp the tail of the rope and pull through all loops, applying tension once the tail is completely through all the loops to form overhand knots.

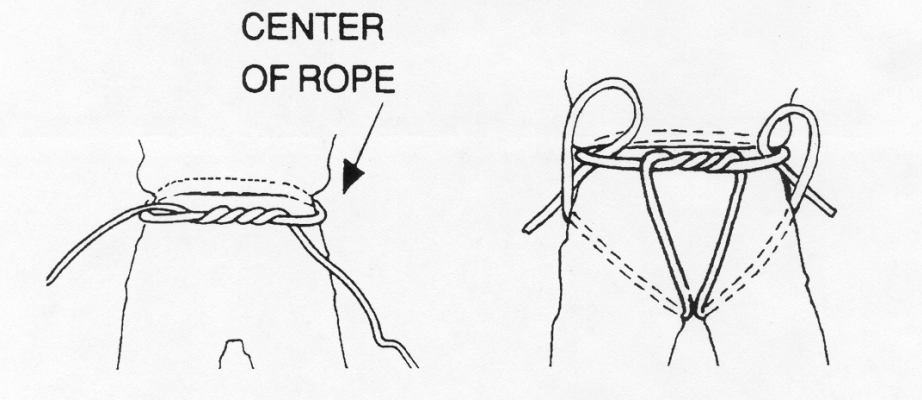
Repeat this process until the rope is completely knotted.

Munter Hitch (Italian Hitch). This is a dynamic mechanical belay device using a carabiner and rope. With the standing end of the rope, form an outboard loop and then bend the rope under the loop to form a bight. Pass both sides of the bight the carabiner gate. This method, when used with kernmantle rope, provides a simple and secure belay. It does not work well with hawser laid ropes because of the kinks created when moving



the hitch through the carabiner.

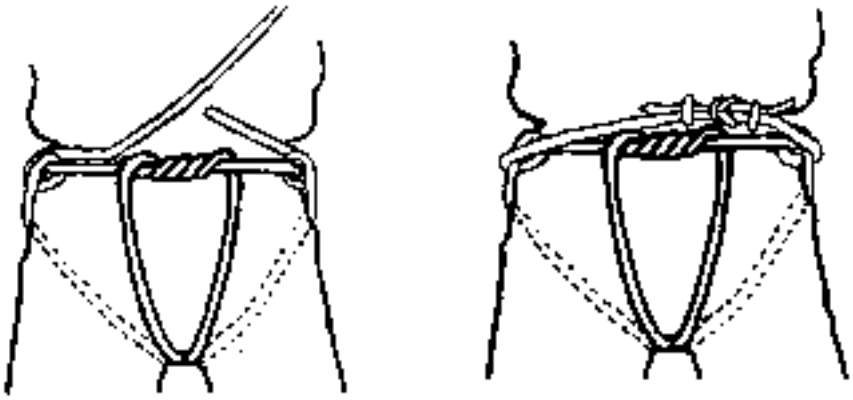
Rappel Seat. This is used as an expedient support harness for rappelling, crossing rope bridges, etc. It is constructed as follows:



a) Center the sag rope on the left hip.

b) Wrap the sling rope around the waist and tie at least one overhand knot (preferably two) in front.

c) Bring the running ends down through the legs, up over the buttocks, and over the original waist wrap, down between the waist wrap and the waist, and over itself, forming a bight. Cinch this up tightly.



d) Now tie a square knot with two overhand knots on the left hip.
e) Tuck any excess rope into a pocket.

Chapter 5. Navigation and Route Selection

5001. Navigation in Mountainous Terrain

Map reading and navigation in mountainous terrain follows the same principles as in more moderate terrain. In mountainous operations, however, navigation and route selection are complicated by:

- Large areas of dead space, which conceal many prominent terrain features.
- Snow covered terrain, which makes terrain look different and hinders orientation.
- Weather conditions can reduce visibility.
- Impassable terrain will require long movements to move a relatively short distance as the crow flies.
- Contour intervals often do not accurately depict the ruggedness of the terrain.
- Rockslide and avalanche potential that constantly dictates the route.

5002. Navigation Techniques

The techniques of navigation are the same for more moderate terrain, although some additional considerations may be applied.

a. Use of Compass. The standard military, lensatic compass functions well in the mountains.

- If you are using a liquid-filled compass, protect it from swinging on its lanyard and breaking the crystal on the rocks.
- Large metal ore deposits in the mountains can create significant error in a compass. If the navigator constantly confirms his position by doing resections, this occasional anomaly will be identified by nonsensical readings.
- Keep the compass away from metal objects such as climbing gear and weapons to prevent their magnetic signature from affecting the compass reading.
- Always refer to the maps declination diagram in order to correct the compass for declination. (e.g. if the declination is 15°E, add 15° to the magnetic bearing to get the true bearing is shown on the map)
- When in doubt, trust the compass. The mountains can be very disorienting, but the compass will not get confused.

b. Magnetic Force. The lines of magnetic force run horizontal to the earth's surface near the equator but are nearly perpendicular close to the poles. Along the equator, a compass needle will lie horizontal. The further the compass is from the equator, north or south, the more the needle will begin to pull toward magnetic vertical. In extreme latitudes, it is possible for the needle to dip enough to keep it from rotating freely. Some commercially available compasses have special needles that compensate for the vertical pull.

c. AN/PSN-11. The AN/PSN-11 is a valuable navigational aid, but does have some mountainous terrain considerations.

- The GPS may not pick up adequate signals in deep gullies and valleys, or in thickly forested terrain.
- They can be damaged if dropped or bumped into rocks.
- They are limited to the life of their batteries, so monitor and conserve battery strength.
- GPS altitude information is often very inaccurate. An altimeter works much better.
- Don't rely on a GPS as a substitute for the compass.

d. Use of maps. Every effort must be made to get the most recent topographical maps for the area of operations. Older maps will often depict old roads and landmarks that don't exist, or not show new ones that have been created. 1:25,000 maps show much more detail than 1:50,000 maps and should be used when choosing routes. Pay close attention to the contour interval. Maps with contour intervals of 40 meters will show the terrain as much more trafficable than it really is. Obstacles such as cliffs and gorges may not even be indicated; creating hazards that could be deadly to Marines navigating at night or in limited visibility.

e. Use of Altimeter. Many manufacturers now produce watches with altimeters. The altimeter is very useful for navigating in mountainous terrain and can be used as a second azimuth to obtain a resection from a map. With known elevation, a navigator can trace his back-azimuth to the according map contour line as indicated with the altimeter. When moving parallel to the contour interval, the unit can maintain an elevation to within 5 to 10 meters. This technique can be used to maintain a certain elevation while traversing a slope. During periods of reduced visibility when landmarks are not available, the altimeter is a priceless tool for navigation. When lakes freeze and become covered with snow, they are indistinguishable for open fields. Use of a map, combined with an altimeter can help distinguish one from the other. The altimeter is also a barometer. It will indicate a rise in barometric pressure when, for example, the altitude on the altimeter drops overnight while you are stationary in your bivouac. This would indicate that a high pressure system is moving in, which typically yields good weather. (See Chapter 2) Even during stable conditions, an erroneous indicated change of 100 feet per day is not uncommon. It is important to "zero" your altimeter at known terrain features on the map that indicate exact altitude, such as most summits and bodies of water. Use the altimeter to determine your rate of ascent or descent. This is valuable information for use in estimating how long it will take to complete a climb or cross a pass. Additionally, an altimeter will let you know if you are on the real summit if visibility is too poor to tell by looking around.

f. Pace count. When a Marine is dead reckoning, he needs an accurate pace count. This can be extremely difficult to maintain in the mountains, as the rapid rise and fall of terrain will adversely affect a regular stride. Pace counters should be designated in every squad. These Marines should practice their pace count going up and down steep terrain. They should practice this while wearing the gear and load that they will be operating with. Often, despite their best efforts, their pace count will be inaccurate due to the frequent traversing (zigzagging) that occurs going up and down hills. Additionally, the actual map distance covered is much less than the ground distance covered because of the

significant angle of slope. This must be closely looked at and accounted for when doing navigation planning. The contour intervals should be counted and multiplied by their value in order to determine actual ground distance covered.

g. Using intermediate objectives. This is a useful technique for when you try to stay exactly on a compass bearing, but get keep running into obstacles such as thick brush, cliffs, or crevasses. Sight past the obstruction to a terrain feature (tree, rock, etc.) that is exactly on the bearing to the principal objective. Then you can move around the obstacle, move to that terrain feature and be confident you are still on the correct route. This technique can be used even when there are no obstacles, allowing you to put the compass away for long stretches and concentrate negotiating the terrain you are presently on.

h. Techniques for snow and fog. In limited visibility, where intermediate objectives are not visible, it is still possible to navigate with the compass. Using another Marine, send them out to the limit of visibility and wave them left or right directly onto the bearing line. Then walk to them and repeat. Though slow, it will allow you to press on toward the objective despite the weather.

5003. Route Planning Considerations

Before any movement, the following considerations should be used to determine your route.

a. Determine the Unit's Ability

- What type of terrain can the weakest climber handle?
- Will they be carrying heavy packs?
- Are vehicles attached? What type of terrain can they handle?
- Is the unit organized, equipped and capable of crossing foreseeable obstacles (cliffs, gorges, streams)?

b. Analyze the Terrain

- Is the route feasible with limited visibility?
- Does the route cross potential avalanche slopes as indicated by map reconnaissance and aerial photograph, if available?
- Does the route offer concealment from enemy direct observation?
- What obstacles can be anticipated?
- Can the security element for the main body negotiate the terrain?
- How will slopes covered with scree, tallus or thick brush impact movement?

c. Analyze the Predicted Weather

- What allowance is made for weather?
- Are designated bivouac sites identified if weather turns bad?

d. Analyze the Tactical Situation/Mission

- How can tracks be camouflaged?
- Where can speed be accomplished without undermining total security?

e. Plan the Route. After all the route planning considerations are evaluated carefully, the route is planned and recorded on a map overlay or route card. The Time-Distance-Factor (TDF) is a guideline and should not be considered as the exact amount of time required for your movement. Furthermore, this formula is for use in ideal conditions.

- 3 kilometers per hour.
- Add 1 hour for every 300 meters ascent.
- Add 1 hour for every 800 meters descent.

5004. Route Selection

While the map overlay is constructed with the planned route, the detailed selection of route during movement is the responsibility of the unit leader. Some of the guidelines are as follows:

- In open space terrain, disperse if possible. Follow the tree line or natural terrain feature.
- Avoid dense forest, if possible. Stay at the edge of wooded areas or in less dense portions.
- Use gentle traverses to ascend or descend mountainous terrain. Once altitude is gained, follow slope contours. Avoid avalanche-prone slopes.
- Bypass obstacles, if possible.
- A route for night movement must follow the easiest possible terrain and should be well marked.
- As you get close to the enemy, shift emphasis from ease of movement to concealment.

Chapter 6. Movement in the Mountains

6001. Foot Movements and Marches

a. Fundamentals of Movement. There are four fundamental principles to conserve energy while moving in a mountainous environment. Marines who have acquired the proper technique for marching in mountains are capable of marching much greater distances than untrained troops. The prime consideration is to conserve the individual's strength and combat efficiency.

- Maintain your body weight over your feet at all times.
- Utilize micro-terrain when possible.
- Stepping over rather than on top of obstacles such as large rocks and fallen trees will help avoid fatigue.
- Make use of the rest step. Use of the balls of the feet alone is avoided. The back knee is locked with each step allowing the skeletal frame to momentarily support the weight instead of only the legs muscles. The use of the rest step over a given distance can reduce the energy expended by up to 50%.

The properly trained individual acquires a steady rhythmic pace, decreasing in speed with the steepness of the slope. When climbing, the length of the regular pace is maintained, the feet are kept flat, and obstacles are avoided by bypassing rather than climbing over them.

b. Types of Slopes. There are four basic types of slopes that will be encountered in a mountainous environment.

- Hard Ground. A hard ground is a slope of firmly packed dirt, with vegetation that will not give way under a man’s step.
- Grassy. A grassy slope is a covered with scattered clumps of grass.
- Scree. A scree slope is a slope consisting of small rocks and gravel, which have collected below a rock ridge or cliff. The size of the rocks varies from sand sized to pieces about the size of a man's fist.
- Talus. A talus slope is similar to a scree slope except that the pieces of rock are fist sized to house size boulders.

c. Techniques for Movement.

- Ascending hard ground.
  (1) The knees should be locked on every step in order to rest the leg muscles (the rest step). This is particularly important on long steep slopes when carrying a heavy pack.
  (2) If the slope is gentle you may be able to walk straight up it.
  (3) Steep slopes should be traversed rather than climbed straight up. When we use the term "traverse" we, mean that you zigzag up the slope, moving in a combination vertically and horizontally.
  (4) When turning at the end of a traverse, always step off in the new direction with the uphill foot. This prevents crossing the feet and a possible loss of your balance.

(5) While traversing, roll your ankles away from the hill to maintain full sole contact.
(6) If the terrain is narrow enough to make traversing impractical, the French Technique can be utilized.

- Descending hard ground.
(1) It is usually easiest to come straight down a hard ground slope without traversing.
(2) Keep your back straight and your knees bent so that they act as shock absorbers for each step.

- Ascending grassy slopes. Step on the uphill side of each tussock or hummock of grass, as the ground will tend to be more level in these spots.

- Descending grassy slopes. It is best to traverse when descending a grassy slope due to the uneven nature of the ground. It is easy to build up too much speed and trip if one attempts to go straight down.

- Ascending scree slopes.
(1) Avoid ascending scree slopes whenever possible, as they are very tiring and difficult to climb.
(2) When ascending is necessary, hard ground principles apply with the addition that each step must be picked carefully and placed slowly so that the foot will not slide down when weight is placed on it.
(3) Kick in the toe of the upper foot so that a step is formed in the scree.
(4) After determining that the steps are stable, carefully transfer weight from the lower foot to the upper foot, and repeat the process.

- Descending scree slopes.
(1) Never run, as this may cause you to lose control, resulting in possible injury to yourself or others.
(2) Plunge stepping is the best method to come straight down a scree slope. This is done by taking bounding steps downhill and hitting with the heal first.

- Ascending talus slopes. Always step on the top of and uphill side of the rocks whether ascending, descending, or traversing. This prevents the rocks from tilting and rolling downhill. Be prepared to yell, “Rock!” if a rock starts rolling downhill.

- Descending talus slopes.
(1) When descending, you must step on the top and uphill side of the rocks. (Same technique as ascending a talus slope).
(2) When a group is descending together, they should be as close to each other as possible (approximately one arm’s length apart) and one behind

another, to prevent possible injury caused by the momentum of a dislodged rock.

d. Effects of Marching. Improper pace or cadence in marching uphill tires troops quickly. Improper descending procedures continually jar the body causing great muscular fatigue and can lead to serious knee injury. This effect is increased by the weight of the pack and results in added strain on the legs, pelvis, spinal column, heart, and lungs.

e. Rate of March. The rate of march is seldom calculated exactly. Time is emphasized over distance when considering troop movements. It is normal to express distance in terms of the time required to cover it, since lateral distances are often irrelevant in a mountainous environment.

f. Pacesetting and Halts. The march unit is normally the company rather than the battalion. The march unit commander maintains the pace. The pace of the column is governed by the most heavily loaded element. It is advisable to make a 5-minute halt to adjust clothing and equipment after the first 15 minutes of marching. Halts, thereafter, will depend largely on the steepness of the slope, altitude, and the condition of the troops. When climbing steep pitches at altitudes in excess of 7000 feet, frequent stand-up halts of about 1-minute duration are beneficial. By taking long, deep breaths, oxygen is more quickly restored to all parts of the body and strength returns at a faster rate. Troops are trained to clear the trail immediately at all halts to allow messengers to move along the column and stragglers to return to their place in the column.

Troops should not routinely march for an hour and then take a 10-minute break. Regardless of the level of training or physical conditioning of the men, unscheduled breaks to fit the terrain and tactical situation are preferable. For example, the steepness of a slope will regulate the amount of breaks necessary. Troops may walk for 1 minute, 10 minutes, or for 40 minutes and then take a short break for half a minute, 1 minute, or 5 minutes. The troops do not sit down nor do they take off their packs or gear. They relax and catch their breath. The troops should remain upright on their feet and take long, deep breaths. The distance covered and the steepness of the terrain will dictate when longer halts are required. For example, a column may march for 1 hour with several periodic short breaks, then stop and take a long 15-minute break.

g. Column Length. When a narrow trail necessitates marching in single file, the length of a rifle company may be nearly 1 mile. The difference in elevation between the head and tail may be more than 4000 feet. On a winding ascent, the trail distance between the point and the main body may be 6000 feet, although the cross-country distance may be only a few yards because the point is almost directly above the main body. Under such conditions, the main body may be closer to the enemy than the point and may be fired upon at the same time as the point or even before the point is engaged. Care must be also taken by the Marines higher up the slope to not dislodge even small stones onto troops below.

h. Selection of Routes. Selection of a route of march is made on the basis of ease in marching as well as tactical security. Factors governing the selection of ridge routes are the availability of good footing, relative ease of contour travel, location of timber lines, and geological formations such as ledges. Primitive trails are usually found along ridges. Highways usually follow the valleys. Movement down a valley without security on the high ground invites ambush. Movement on the crest of a ridge, where some of the best trails are found, advertises movements and invites enemy fire. Movement above the tree line reduces the amount of protective cover afforded at lower elevations. Timing and planning are important in order to avoid halts or bivouacs on exposed terrain.

Marines must know the terrain to determine the feasible routes for cross-country movement when there are no roads or trails.

Information requirements should include topographic and photographic map coverage as well as detailed weather history for the area of operations. When planning mountain operations, it may be necessary to obtain additional information on size, location, and characteristics of landforms and drainage, types of rock and soil, and the density and distribution of vegetation.

i. Selection of Objectives. Time and distance required to reach destinations are invariably underestimated because of the optical illusion created by clear air, and the perspective gained when looking down from heights and across intervening depressions. Particular care is taken to select objectives that can be reached within the time available. If possible, primary and alternate routes to the destination are reconnoitered by aircraft before and during the move. An unexpected extension of a march often produces undue exhaustion and results in a late arrival, a poorly prepared bivouac, and insufficient security.

j. Movement over Difficult Terrain. Movement over extremely difficult terrain such as cliffs, rocky crags, ravines, glaciers, or deep snow requires special preparations, training, techniques, and equipment. On steep slopes, columns of pack animals are not permitted to get off the trails. Foot troops negotiate such slopes by traversing or zigzagging.

k. Night Marches. When contact with the enemy is imminent or has been gained, most marches are conducted at night. Such marches are very difficult, often dangerous, and excessively tiring. Daylight reconnaissance and marking of routes, as well as competent guides, are essential to the success of a night march. Distances between men, animals, and units are decreased. While bright moonlight makes a night march easier, it also improves enemy observation. It is extremely difficult to move along a rocky path at night without noise. Dislodging a single rock may start a landslide that can be heard over a mile away. Shoes of pack animals and hobnailed shoes create telltale sparks. When marching through woods or areas where trails are many and indistinct, numerous connecting files are required between march units in order to maintain continuous contact. It is usually impossible for anyone to move up or down a column on a mountain

path at night to check on distances and maintain march discipline. All orders are relayed backward and forward through the column.

l. Marches in Clouds or Fog. Marches in clouds or fog present some of the same difficulties as night marches. Keeping a sense of direction is difficult since clouds are often so dense that one can hardly see the ground. Such conditions necessitate close columns, a slow pace, and the use of audible signals. The crowding together of units may cause serious tactical disadvantages when the fog or cloud lifts.

m. Weather. The erratic weather characteristic in the mountains requires that Marines must be prepared for wide variations in temperature, and types and amounts of precipitation. It may be logistically impossible to resupply each man with the gear he needs for every occasion; therefore, each man must be self-sufficient to cope with normal weather changes using materials from his rucksack. Movement during a storm is difficult due to poor visibility and bad footing on steep terrain. Although the temperature is often higher during a storm than during clear weather, the dampness of rain and snow, and the penetration of wind cause Marines to chill quickly. If possible, it is best to get off the high ground and seek shelter and warmth during severe mountain storms (although reduced visibility may permit tactical surprise to be used by capable commanders).

When the tactical situation requires continued movement during a storm, the following precautions should be observed:

- Maintain visual contact.
- Keep warm. Maintain energy and body heat by eating and drinking often; carry food that can be eaten quickly and while on the move.
- Keep dry. Wear wet-weather clothing when appropriate, but do not overdress, which can cause excessive perspiration and dampen clothing. As soon as the objective is reached and shelter secured, put on dry clothing.
- Do not rush. Hasty movement during storms leads to breaks in contact and accidents.
- Do not use ravines as routes of approach during a storm as they often fill with water and are prone to flash floods.
- Avoid high pinnacles and ridgelines during electrical storms.
- Avoid areas of potential avalanche or rockfall danger. During and immediately after storms is when they are most unstable and likely to slide.

n. Hazards to Movement. Hazards can be termed natural (caused by natural occurrence), man-made (caused by an individual: lack of preparation, carelessness, improper diet, equipment misuse), or combination (human trigger).

Rockfall. This is probably the most common (natural) hazard encountered by the military mountaineer. An understanding of its causes, and measures used to lessen its impact, is essential. Rockfall can also be man-made or a combination of factors.
The structure and composition of a rock area should be studied. Rock that has been subjected to severe weathering is more prone to rockfall. A "soft" rock (found in

sedimentary formations) is more prone to rockfall than is solid, glaciated granite. Stratified rock (slate and shale) can be loose and unstable.

Indicators of rockfall must be learned and observed in the field. Fresh debris at the bottom of the cliff or scree at the bottom of gullies are indicators of rockfall. It is also important to know at what different time of the day rockfall is most likely to occur. Rockfall usually occurs early in the day on east and south mountain faces as the sun first warms them, and it occurs in late afternoon on west and north faces. This is because of the freeze-thaw cycle that occurs. As water freezes to ice, it slowly expands, serving as a wedge between the rocks; as the water thaws, the wedge disappears and the rocks are left without support, causing them to be unstable and subject to dislodging. The weight of a man on the rocks will often be more than enough to disturb the balance, and create a major rockslide.

Icefall. This is a common hazard when conducting operations on snow, ice, or glaciated terrain. It may be triggered by natural, man-made, or a combination of factors. Icefall occurs in many of the same ways as rockfall. Therefore, the parameters of rockfall apply to ice as well.

Avalanches. The effects of an avalanche can be disastrous to the military mountaineer. Chances for a Marine to survive after burial by an avalanche are about 50 percent after 30 minutes. After two hours, chances for survival are remote.

Lightning. The danger from lightning is greater on rock than on snow or ice. Lightning kills people by passing through the heart and causing coronary arrest. Lightning can be expected when static electricity is great enough to cause tickling of the scalp, the hair to stand up, and a slight crackling and appearance of a blue light (St. Elmo's fire) on metal objects. The threat of injury due to lightning can be reduced in the following ways during a thunderstorm:

- Avoid summits and ridges and open areas.
- Stay away from prominent objects, mainly metal objects, and solitary trees.
- Avoid gullies filled with water.
- Avoid overhangs and recesses.
- Avoid cracks in wet rock; lightning ground currents follow them.
- Keep the hands and upper torso insulated from the ground. Avoid metallic objects extending from the upper body to the ground.
- Turn off all radios until the storm has passed. Disconnect all radios from remotely sited antennas.

Crevasses. Crevasses are formed when a glacier flows over a slope and makes a bend, or when a glacier separates from the rock walls that enclose it. A slope of only 2 to 3 degrees is enough to form a crevasse. As this slope increases from 25 to 30 degrees, hazardous icefalls can be formed. Likewise, as a glacier makes a bend, it is likely that crevasses will form at the outside of the bend. Therefore, the safest route on a glacier would be to the inside of bends, and away from steep slopes and ice falls. Extreme care must be taken when moving off of or onto the glacier because of the moat that is most

likely to be present. Mountain Leaders are trained in the techniques required for moving over glaciated terrain and should be used to find a safe route.

o. Cover and Concealment. When moving in the mountains, cover can be provided by outcropping boulders, heavy vegetation, and intermediate terrain features that mask maneuver. Digging of fighting positions and temporary fortifications is difficult because soil is often thin or stony. The selection of dug-in positions requires detailed planning. Some rock types such as volcanic tuff are easily excavated. In other areas, boulders and other loose rocks can be used for building hasty fortifications. In alpine environments, snow and ice blocks may be cut and stacked to supplement dug-in positions. As in all operations, positions and routes must be camouflaged to blend in with the surrounding terrain and prevent aerial detection.

p. Snow Covered Terrain. In snow-covered terrain the stark contrast between light and dark emphasizes any item which does not blend naturally with its surroundings. Furthermore, every movement by vehicles or dismounted troops leaves readily identifiable tracks in the snow that can provide detailed intelligence to an enemy. Also, backgrounds are not necessarily all white. Rocks, brush, trees and shadows make sharp contrast with the snow. It is essential that individual Marines understand these basic concepts in order to effectively camouflage themselves, their equipment and their vehicles in snow covered terrain. For more detailed information on cold weather operations, see MCRP 3-35.1A, *Small Unit Leader's Guide to Cold Weather Operations.*
Individual Concealment. A thorough reconnaissance and terrain analysis is required in order for the small-unit leader to proscribe proper camouflage patterns. By using a combination of green woodland and overwhite articles of clothing, four different color schemes can be used depending on terrain.
Thickly Wooded. These areas consist mainly of secondary growth coniferous or deciduous trees with thick underbrush. An all green clothing combination is normally best.
Low Brush/Light Scrub**.** These areas are often found at and above the tree line or in hilly areas with poor soil. In most cases and open snow background predominates and a combination of with over green is usually suitable.
Forest. These areas are covered with primary growth, coniferous and deciduous, of varying density, with little underbrush. The normal clothing combination here is green over white.
Above Tree Line. Even above the tree line, terrain is not solely white. Exposed rock and shadows change the view. Commanders should carefully observe the area. All-white camouflage is usually best. In areas of exposed rock, deep shadows or exposed brush, however, it may be best to roll up a leg or arm of the overwhites to provide for some contrast.
Weapons and Equipment. Equipment is relatively easy to camouflage with good results being achieved by the use of matte white paint or white tape. Plastic, adhesive tape works best but should be applied in a warm environment, and when applied to weapons, should not interfere with the operating groups. Group equipment, such as sleds and tents, should be white, but will be camouflaged additionally based on background terrain. In wooded terrain, the area around the bivouac site can be improved by thickening it with

branches; small trees or branches can also be suspended above the tents to break up the silhouette. In predominately snow covered terrain, tents and other large equipment must be dug in, then concealed by draping white camouflage netting over.

q. Observation. Observation in mountains varies because of weather and ground cover. The dominating height of mountainous terrain permits excellent long-range observation. However, rapidly changing weather with frequent periods of high winds, rain, snow, sleet, hail, and fog can limit visibility. The rugged nature of the terrain often produces dead space at midranges.

Low cloud cover at higher elevations may neutralize the effectiveness of OPs established on peaks or mountaintops. High wind speeds and sound often mask the noises of troop movement. Several OPs may need to be established laterally, in depth, and at varying altitudes to provide visual coverage of the battle area. The use of these mountain pickets is described in paragraph 6002. d. below.

Conversely, the nature of the terrain can be used to provide concealment from observation. This concealment can be obtained in the aforementioned dead space. Mountainous regions are subject to intense shadowing affects when the sun is low in relatively clear skies. The contrast from lighted to shaded areas is such that visual acuity in the shaded regions is considerably reduced. These shadowed areas can provide increased concealment when combined with other camouflaging disciplines and should be considered in maneuver plans.

Marines operating in mountainous regions should be well trained in the use of night vision goggles (NVGs). Periods of darkness provide excellent opportunities for unobserved movement by Marines knowledgeable in the use of night vision goggles. These NVGs can be used in static or moving applications in both offensive and defensive operations.

r. Load Considerations. The individual's load (weapon/ammunition and pack) is a great impediment to mobility. Commanders must make every effort to move nonessential equipment and to reduce each Marine's individual load to an absolute minimum. Minimal essential supplies and equipment must be carried. The individual fighting load must not inhibit the Marine's capability to fight once he arrives at the objective. (See Annex A, Warfighting Load Requirements for a detailed list of necessary gear.)

The primary consideration is not how much a Marine can carry, but how much can be carried *without* impaired combat effectiveness-moral or physical. The combat strength of a unit is not counted simply in numbers of Marines, but in numbers of Marines physically able and eager to engage the enemy. It is generally better to risk temporary inconvenience from lack of health and comfort items than to exhaust Marines due to overloading.

It is fundamental truth that men become physically exhausted more quickly when under the stress of combat. Marines must carry less into battle than they are conditioned to carry in training. Marines should be conditioned for carrying weight but should be equipped in combat for fleetness on foot.

A common mistake is to base the fighting load on the gear and supplies necessary to meet every contingency. The commander cannot reasonably expect to carry enough gear for every possible eventuality. The items to be carried must be based on likely expectations. It is the commander's responsibility to produce transport to carry additional gear. As a rule of thumb, a Rifle Company or unit of similar size requires one 5-ton truck and trailer. In mountainous operations, support assets such as helicopters, trucks, LAV, AAV, or mules may be provided. Commanders must use them wisely to take the load off their Marines. These assets may have to be shared with others who have responsibilities such as logistics, MEDEVAC, etc., which also require extensive use of support assets.

The commander must ensure that the supply system provides, on a dependable and timely basis, the balance of essential supplies and equipment not carried by the unit. Marines must feel confident that they will be supported with the necessary supplies and equipment.

Specific loads that should be considered are:

ITEM	POUNDS
180 rounds of 5.56 mm	7.7
(4) M-67 fragmentation grenades	6.8
(1) SMAW Rocket	29.3
(1) M-720, 60 mm Mortar w/ multipurpose fuse	7

6002. Security.

a. Command of the High Ground. As described earlier from the friendly perspective, mountainous terrain likewise offers many vantage points for enemy observation and ambush. It is necessary to place special emphasis on security. Commanding ground should be occupied immediately by security detachments strong enough to hold it against hostile combat patrols. Enemy positions that are not readily accessible to friendly troops without undue loss of time may need to be neutralized by air attack, artillery, or infantry heavy weapons so as not to impede the progress of the main body.

b. Enemy Capabilities. When opposed by well-trained and aggressive enemy mountain troops, commanders should expect that the enemy is not going to be restricted by seemingly impossible mountain ranges or terrain. As a result, every conceivable approach is guarded. The nature of the terrain and network of communications may force the enemy to concentrate his forces. At night, enemy infiltration is a constant danger, especially for rear area installations. The use of additional troops is sometimes necessary in order to adequately protect these installations.

c. Listening Posts. A person's voice in a valley frequently can be heard on ridges 3000 feet above. Consequently, valley approaches as well as ridge approaches are often covered by listening posts high upon ridges. However, thorough coverage of a valley approach may also require listening posts to be located in the valley.

d. Flank Security. Because of the great amount of time normally required for flank security to reach and occupy dominant terrain features, they move well in advance of the main body. When practical, they are moved by helicopter. In the winter, highly trained ski troops may be used for such missions. If the sides of a valley are very steep and rise over 3000 feet from the valley floor, the strength and number of flank guards, patrols, reconnaissance patrols and air observers must be increased. Commanders must consider the physical limitations that the terrain imposes along the route selected for any security detachment. Communications between security elements and the main body, often impossible except by radio, is another limiting factor. Semaphore should be considered. Roads and trails paralleling the route of the main body are seldom available. Therefore, the movement of patrols across country over rough and difficult terrain is slow and fatiguing. Fixed flank (mountain pickets) units may be dispatched in advance of the main body movement or inserted by helicopter to occupy vantage points along the route of march.

Mountain Picketing. Combat reports from the 1979-1989 conflict between the Soviet Union and Afghanistan *Mujahideen* rebels reveal several lessons regarding military operations in mountainous terrain. Offensive operations in Afghanistan oftentimes required the units to command adjacent ridgelines prior to “sweeping” a corridor of interest. Without forces on the dominating terrain, it was difficult to effectively observe or engage enemy units in the corridor. Such mountainous terrain as was encountered by the Soviets in Afghanistan may prevent local flank security elements from providing the necessary protection. Mountain picketing is an expanded concept of the techniques of flank and all-around security. The mission of the mountain picket force is to prevent the enemy from bringing effective flanking fire or observation onto bear on the main body. Deploy mountain picket forces on high ground to protect the main body by domination of the high ground, by additional flank security and by linking units or subunits by observation and support fire when units are channeled into corridors by the nature of the terrain. Local flank security is fundamental to our tactics and familiar to all Marines; however, mountain pickets have distinct, additional advantages and disadvantages.

- Advantages: Mountain pickets overlooking the route provide the main element with increased security and constant coverage by supporting teams. While traveling along dominating ridgelines, these pickets are also more likely to maintain communication with fire support agencies, and are thereby in the best position to direct fire support.

- Disadvantages: If moving adjacent to the main body, mountain pickets will likely move through more arduous terrain than the main body, thus slowing the main body’s rate of movement. Concealment is paramount as pickets typically deploy above the tree line. Control and communication is difficult between main body and pickets due to physical separation and frequent lack of visual contact.

Pickets are particularly effective during "clearing" missions or other tasks that require a main body to physically travel a corridor. The pickets can travel slightly ahead of the main body and provide reconnaissance information to the main body. In defending the main body against ambush, frontal or flank attack, mountain pickets will have the best observation for directing fire support. Hence, attaching forward observers and FACs to the mountain picket could maximize fire support flexibility for the commander.
In order to effectively coordinate their movement, the main body must design a solid movement scheme of maneuver that uses checkpoints and phase lines. These coordinating measures assist not only in reporting procedures, but also for the commander to ensure that the movement of separate units is synchronized and controlled. Elements dispersed from the main body, such as far flank security, must have established priority of fires and conduct of fire nets in order to effectively coordinate fire support.

6003. Bivouacs

a. Site Selection. Most mountainous regions offer few bivouac sites suitable for large elements of the MAGTF. The limiting number of areas and the increased lengths of columns usually require battalions, companies, or platoons to bivouac separately at the nearest suitable spot to the halting point. The search for suitable bivouac sites must commence while ample daylight remains, rather than struggling on until the last strength and last light vanish together.

b. Considerations. After first considering security, priority is given to protection from the weather. Companies bivouac in any formation suitable for perimeter defense. When suitable concealment is available, the companies bivouac astride the road or trail being used with trails made for flank platoons.

c. Element Size. The use of platoon bivouacs reduces the time required to close up at night and to move out in the morning. The battalion commander, when issuing his order to halt, indicates whether the battalion is to close into platoon or company bivouacs, depending on the density of cover, the length of the column, and his mission the following day. The actual setup of bivouacs varies considerably due to the irregularities of the terrain.

d. Bivouac Improvement. Living conditions are continually improved if the same area is to be used for more than one night. Temporary shelters may be improvised by digging into the side of a slope or using shelter halves or pieces of canvas covered with grass or branches for roofing. In a stable situation, bombproof caverns are blasted out of bedrock and used for supply storage and quarters. Troops are cautioned against laying gear on the ground. Even during summer months, local storms are not uncommon, and valuable time may be lost searching for items buried in the snow or washed away in a torrent.

6004. Employment of Helicopters. The helicopter is one of the best means at the MAGTF's disposal to overcome the maneuver restrictions of mountainous terrain. It can move a unit farther and faster than any other means of transportation. However, the helicopter is not without its limitations, the greatest of which is the lack of dependability due to unpredictable weather. This means that the unit leader must always have an alternate movement plan to get to the destination in time to accomplish the mission. Use the helicopter whenever possible, but avoid of becoming totally dependent on it. Properly employed, its influence on operations in such an area can be tremendous.

a. Helicopter Movement. In mountain operations, helicopters serve as assault support for personnel and logistics. Helicopters are used for security, reconnaissance, communications, command and control, logistics missions, and troop movements, both tactical and administrative. RWCAS is discussed in Chapter 8.

- Helicopters are frequently used to land small security elements (mountain pickets) on key terrain features. These elements conduct observation over assigned areas and provide security to the MAGTF. The helicopter permits the commander to emplace, relieve, and move security elements rapidly and economically.
- Helicopters may be employed to provide forward reconnaissance and advance warning to MAGTF elements on the march.
- Helicopters may carry out distant aerial visual and aerial photographic missions.
- The helicopter is used to move tactical units rapidly during critical phases of mountain operations. It is of particular value in the early stages of the amphibious assault when advantageous terrain overlooking the landing beaches is to be seized to permit the early development of combat power ashore.
- In subsequent operations ashore, other means of movement, such as motor transport, pack animals and foot travel, are not completely disregarded. By integrating the use of these means with the use of the helicopter, the MAGTF commander has considerable flexibility in maneuvering his subordinate elements.
- Terrain restricts the movement of fire support means to a greater degree than it restricts the movement and mobility of troop formations. Helicopters are capable of moving most light and medium artillery and smaller caliber weapons in precipitous mountain terrain, which might otherwise be inaccessible. Supporting arms emplaced with the aid of helicopters, in all probability, will require further air support for ammunition resupply. Consideration must also be given to displacement of the pieces, which will have to be moved by helicopters or left in place. Movements conducted in a snow covered helicopter landing zone (HLZ) must consider the danger of blowing snow, wind chill and the signature presented by the snow clouds created by the prop wash.
- Helicopters provide an effective means of establishing and maintaining regular messenger service.

- The semi-independent nature of mountain operations normally reduces the opportunity for detailed command supervision of combat actions and liaison between units. The helicopter permits the commander to move freely about the battlefield and in order to be where he can exert his influence at the decisive time and place.
- In mountain operations, the helicopter makes it possible for elements of the MAGTF to be resupplied faster than by other means. Seriously wounded personnel can be medevaced by helicopters to field hospitals or ships.

b. Influence of Mountains on Helicopter operations. Principal limitations imposed on the employment of helicopters in a mountain environment consist of altitude (air density), wind, and limited landing sites.

- Altitude has a direct effect upon the lift capability of the helicopter. The extreme of altitude results in a decreased power efficiency in lift capability. An analogy to this reduction can be made with the standard automobile engine, which develops maximum power at low altitudes and loses power in high altitudes. There is also a reduction in the rotor blade capability to produce the desired lift as air density is reduced. The combination of loss of engine power and reduced lift capability decreases the overall load carrying ability of the helicopter.
- Strong or gusty winds may affect the maneuverability and control of helicopters. Wind effects may preclude the use of some landing sites due to turbulence or down drafts.
- The very nature of the terrain in mountains restricts commanders in selecting landing sites that would facilitate the accomplishment of their mission. This restriction of terrain means that there are generally fewer landing sites, and when available, they require much more preparation than non-mountainous terrain. The effects of altitude and wind effects or a combination of both may further limit landing sites. Accordingly, special emphasis is placed on the preparation of landing sites in many instances; it may be necessary for engineers with appropriate demolitions and power tools to rappel down from helicopters to potential landing sites.
- In snow covered terrain the signature provided by the blowing snow will easily identify the HLZ up to 15 km away.

c. Landing Zones. Helicopter operations in a mountainous or snow-covered landing zone (LZ) are slower. Loading, unloading, approaches and departures, seat belt hook-ups, crew-chief directions, and finally, passenger and aircrew coordination all take more time. Plan for these delays. The information below is intended not for helicopter support team personnel, but for are additional considerations for LZ selection in a mountainous environment for small-unit leaders.

- Ground Slope. The slope should be no more than 8 degrees. Helicopters may tip over while landing on slopes greater than 8 degrees.
- Cover and Concealment. The LZ is should be concealed from direct enemy fields of fire and observation.

- Obstacles. Look for obstacles that may be hidden under the snow: large rocks, tree stumps, fence posts, etc.
- Elevation. It may be necessary to plan for LZ's at lower elevations because of the negative effect of altitude on aircraft performance. In peacetime, USMC helicopters have a ceiling of 10,000 feet.

d. Planning. Helicopters will often have reduced payloads when operating at higher altitudes. In addition, high temperature, high humidity and high Density Altitude will degrade helicopter performance. Consequently, helicopter payloads may change significantly in a short period due to both the current and forecasted weather and LZ altitudes. Marines must have the flexibility to change their embarkation plans based on the varying conditions and helicopter support available. Prior detailed planning by unit commanders will greatly assist in quick helicopter operations.

HELICOPTER	SEA LEVEL	5,000 FT MSL	10,000 FT MSL
UH-1N	6 pax and gear	4 pax and gear	2 pax and gear
CH-46E	12 pax and gear	8 pax and gear	6 pax and gear
CH-53E	24 pax and gear	24 pax and gear	18 pax and gear
MV-22	12 pax and gear	10 pax and gear	6 pax and gear

These numbers are estimates only. Actual lift capacity will vary depending on fuel consumption, ordnance on board, time of flight, weather, etc.
The UH-60 should be treated similar to a CH-46 for planning purposes.
The CH-47 should be treated similar to a CH-53 for planning purposes.

6005. Pack Animals.

a. General. The types of transportation used in operation will vary widely, depending upon local conditions such as roads, terrain, and distances to be covered. In some cases the seasons of the year will be a controlling factor. During operations in the past, every possible type of transportation known to mankind has been used, from railroad, aviation, motor transportation, to dogs, elephants, camels, and porter service.

It is safe to say that the type of transportation most suitable to any specific country is that which is being used there by the locals. A study of these local methods, together with the local conditions, will aid the commander in determining the type of transportation to be used by the intervening forces. In countries where mountain operations usually take place, the roads are generally poor and exist in only a few localities. When there is a season of heavy rain, it is most probable that most roads and trails will become impassable for trucks and tractor-trailer transportation. For this reason, other means of transportation must be utilized. Animals, carts, boats, or porter transportation will have to be used where there are no passable roads, trails, or railroads.

b. Animal Transportation. The use of animals for the purpose of transportation supplies has been one of the most generally used methods of transportation in small-wars operations. Without the pack animal, operations far into the interior of a mountainous

and unsettled area, devoid of roads, are impracticable if not impossible. However, the use of pack animals is not a simple or always a satisfactory solution to a transportation problem. Crude or improvised pack equipment, unconditioned animals, and the general lack of knowledge in the elementary principles of animal management and pack transportation will tend to make the use of pack transportation difficult, costly, and possibly unsatisfactory.

The efficiency with which the pack train is handled has a direct and material effect on the mobility of the column which it accommodates. With an inefficient pack train, the hour of starting, the route of march, and the amount of distance covered are noticeably affected. On the other hand, with conditioned animals, good modern equipment, and personnel with a moderate amount of training in handling packs, the pack train can accommodate itself to the march of the column and not materially hamper its mobility.

If time permits it is highly important to have the animals that are to be used for transporting supplies accustomed to the firing of rifles and automatic weapons, so that they will not be frightened and try to runaway if contact is made. This can be done by firing weapons while these animals are in a place which they are familiar and preferably while they are feeding. The firing should be done at some distance first and gradually moved closer as the animals get accustomed to the noise. In a short time the animals will pay no attention to the reports when they find that it does not hurt them. If this is impossible, and an animal carrying important cargo, such as machine gun ammunition, is frightened and tries to bolt, the animal should be shot to prevent them from falling into the hands of opposing forces.

Pack animals must be conditioned before being taken on an extended march or heavy losses of animals will result. The march should begin immediately after the last animal is packed.

c. History. Primitive man soon realized that animals could assist him in carrying his loads, thus domestication began. Man has tried to pack almost every animal he has domesticated; oxen, cows, camels, horses, mules, water buffaloes, elephants, yaks, llamas, dogs, sheep, donkeys, and reindeer, just to name a few. One of the first recorded military applications of pack horses and mules was by Genghis Khan. Our present day pack systems have grown out of several systems which were used during the 1850's. The best features of each system were used to develop present-day equipment and procedures.

The Marine Corps has used pack animals basically from its inception until 1953, when the last pack mule, was retired. The last military publication on packing animals was by the U.S. Army in 1914.

d. Important Points in Packing

(1) Loads and distances traveled must be adjusted to the conditions of the animals. Pack animals must not be overloaded.

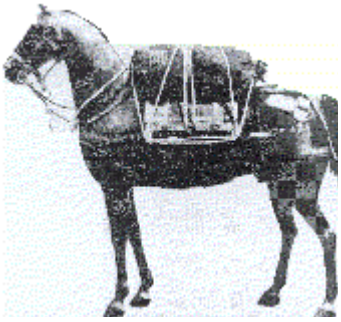
(2) When packing, the time interval between placing the loads on the first and last animal should be reduced to an absolute minimum. This time interval should never exceed 30 minutes.
(3) All equipment should be assembled neatly and arranged the night before a march is to begin. Every single item should be checked; otherwise needless delays will result in the morning.
(4) All cargoes should be weighed, balanced, and lashed up the night before a march is to begin.
(5) A standard system should be established for stowing all pack gear and cargo loads for the night. This facilitates the checking of equipment after the halt and greatly reduces the number of lost pieces. A satisfactory system is to place saddles on the ground in a row just in rear of the picket line or, if the animals are pastured at night, place them on line in a space suitable for packing up in the morning. The harness, lash ropes, and all other gear belonging to that particular saddle and its load should be placed on top of each saddle. The loads should be placed in a row parallel to the saddles; each load in the rear of the saddle on which it is to be packed. Only by careful planning and by systematic arrangement can delays in packing up be averted.

e. Native Packers. Native packers have been used to a good advantage. Two natives experienced in packing are generally hired for every 10 animals, since two men are required to pack each animal and hence work in pairs. A good system is to hire a competent Chief Packer and allow him to hire the necessary number of packers. With such an arrangement, all orders and instructions should be issued through the Chief Packer and he should be held responsible for the handling of the cargoes of the animals.

f. Marines as Packers. The average Marine can be trained in a fairly short time to pack mules more securely and more rapidly than the average Native mule driver, and in regions where pack transportation is used, every Marine should be taught to pack. The use of Marines as packers has the effect of decreasing to some extent the combat strength of the column, however the advantages may outweigh the disadvantages.

MACHINE GUN AMMUNIITION LOAD.
Showing space on top of saddle for additional equipmen

In some cases it may be undesirable or impracticable to include Native Packers in a combat patrol. The hiring of native packers may gives the local populace warning that the column is about to move out. The train is more efficiently handled by Marines. Ammunition and weapon loads should always be led by Marines, rather than herded or turned over to natives.



g. Pack Trains. Pack trains which carry supplies, baggage, ammunition, and weapons of combat columns should be made as mobile as possible. Both the number of the animals and the cargo loads should be as small as is consistent with the absolute needs of the column. If there is a choice, it is better to increase the number of animals than to increase the individual cargo loads.

In general, the pack loads accompanying a combat column should never exceed 25% of the weight of the pack animal in which it is to be placed on. For small horses and mules the average load is about 130 pounds. This is a general rule of thumb and loads must be considered to the conditions of the trails and the animal. Some loads will exceed this amount and selection of the animals by the size, strength, and overall condition must be considered.

Chapter 7. Weapons Employment in the Mountains

7001. Factors affecting infantry weapons. The mountainous environment will have considerable effects on weapons capabilities and employment techniques. Failure to understand these factors can result in mission failure. A detailed discussion of the effects of cold on weapons is provided in Chapter 7, MCRP 3-35.1A, *Small Unit Leader's Guide to Cold Weather Operations.* The following must be considered when employing weapons in the mountains:

- **Increase in the use of overhead and long range fire.** The compartmentalized terrain will require overhead fire to occur, as it may be difficult to support an attack from flanking terrain if it is not controlled. Additionally, the great differences in weapon to target elevation and the good observation afforded will allow machine gunners to more safely and accurately conduct overhead fire.
- **Lack of grazing fire.** The steepness of slopes and irregularities of terrain prevent the ability to achieve grazing fire from automatic weapons and limit the extent of beaten zones.
- **Difficult range estimation.** An observer looking downward from a height tends to underestimate the range; an observer looking upward from low ground tends to overestimate the range. Use of laser range finders is encouraged.
- **Benefits of high angle of fire weapons.** The existence of a great amount of dead space gives added importance to weapons with a high angle of fire, as well as to hand grenades and grenade launchers.
- **Ammunition discipline.** The difficulties in ammunition resupply make strict fire discipline mandatory. The availability of helicopter resupply will reduce this problem if available.
- **Mutual support** from one terrain feature to another is facilitated by good observation. Care must be taken to do a good map study when emplacing mutually supporting weapons to ensure they are within range and firing angle of one another.
- **High angle shooting.** Rounds will impact over the target when shooting at a high angle (up or down) unless calculations are made and the angle is compensated for. See Slope Angle below.
- **Reduced range**. The thinner air (less dense) at high altitude will increase the range of a round, however cold air is denser and also results in a slower burning of the propellant, thus reducing the range of the round.
- **Slow displacement.** The rugged terrain will make mobility and rapid displacement of crew served weapons more difficult. Well-rehearsed SOPs will reduce the amount of displacement time. Crew served weapons teams should be familiar with the use of rope systems to move their weapons around rugged terrain.
- **Increased signature.** Firing in dry areas will create a large signature of dust. Lay down MRE boxes or wet the dirt in front of the muzzle. The smoke from rockets and missiles can also be easily seen far away by the enemy, so plan on moving out quickly after firing to avoid becoming a target. Avoid firing on

frontal slopes to reduce vulnerability to enemy observation and countermeasures.

a. Slope Angle. When shooting uphill or downhill, the trajectory of the round will be the same as when shooting level, however, gravity will only affect the round over the HORIZONTAL DISTANCE between shooter and target NOT LINE-OF-SIGHT DISTANCE. This is because gravity affects the flight (trajectory) of the round only in the horizontal plane. The greater the angle between shooter and target the higher the round will impact if unadjusted.

There are 2 ways to compensate for this: The simple method and trigonometry.

The simple method has a few techniques.

- Estimate the horizontal distance to target rather than line-of sight (Caution; laser range finders determine line-of-sight distance at this time. Future models will compensate for slope angle.). Your map provides horizontal distance, use it. Use this distance on your sight setting.
- Aim at 6 o'clock on your target...whether shooting uphill or downhill.
- When making range cards, use reference points that are on the map so you have the horizontal distance (sight setting) or shoot and adjust on to T.R.P.s and log the sight settings on the range card.

The USMC sniper manual and pocket guides have High Angle of Fire tables and the cosines for slope angles from 0 to 90 degrees. Measure the slope angle from muzzle to the target using a clinometer. (Field expedient clinometer: use a protractor with a weighted piece of string tied middle. Place the bottom of the protractor on the muzzle as it is sighted on the target and read what angle the string crosses on the protractor.) Find the cosine for that angle (from a chart or calculator) and multiply it by the estimated (line-of-sight) range. This will give you the flat range, which is used for sight settings.

Angle Shooting – Calculations and Charts

Calculations:

Horizontal mil reading:

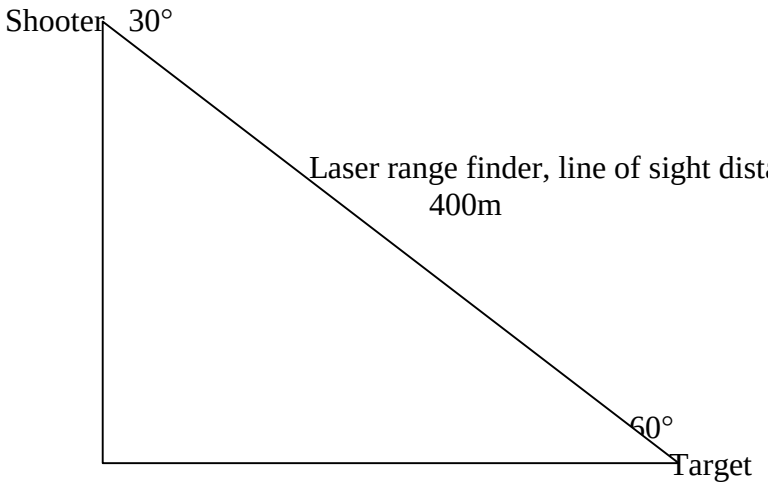
Determined (estimated line-of-sight) Range x Cosine = Range (for sight setting)

Vertical mil reading:

Determined (estimated line-of-sight) Range x Cosine x Cosine = Range (for sight setting)

EXAMPLE CALCULATION:

The determined slope angle (with clinometer) is 30 degrees. The determined distance (line of sight) is 400m (with a laser range finder). Find the cosine for 30 degrees – which is .87. Multiply .87 x 400 = 348. The sight setting for the weapon is for 348m.



Sight setting for weapon when shooting uphill or downhill

7002. Employment of crew served weapons.

a. Mortars. In the mountains, mortars may be the only indirect fire asset available to units of Company size and below. Artillery may be in support of another unit, or the terrain may mask its fires. Because it is a high angle of fire weapon, the mortar is ideal for dropping rounds into enemy defilade positions and rooting out a well-entrenched enemy. Small unit leaders must master the employment of this weapon and combine its use with their direct fire weapons in order to employ combined arms and create a dilemma for the enemy.

In rocky terrain, it is hard to find a good base for the baseplate. The baseplate must be buffed to prevent cracking or shattering it. Sand bags half filled, pine boughs, etc. can be used for buffing. Too little buffing can result in breakage, too much will cause the baseplate to shift or collapse after each fired round. Always carry empty sandbags.

In a snowfield, it is best to dig down to the ground. If the ground is frozen, it must be buffed or thawed. The cold and frozen ground will break a baseplate just like rocky ground. If set on snow, a flotation platform must be constructed. Layers of pine boughs and snow, sand bags filled with snow, etc. can be used. Buffing considerations are the same as on rocky ground.

Positions are likely to be on the valley floors, so a retrans site may be required to be positioned on top of a piece of surrounding high ground to establish comm between the FDC and the FOs. This requirement increases the displacement time for mortar sections and should be planned for. Training in field expedient antennas should be conducted and gear needed to make them should be kept with each mortar section.

In the attack, it can be difficult to provide sufficient ammo for all tubes. In this situation, it is better to advance fewer tubes and more ammo. This will primarily affect the 60mm mortar. The 81mm mortar platoon will typically only experience an ammo shortage if they must separate from their HMMWV and resupply due to the rugged terrain.

FOs will take more time and ammo to adjust onto target due to the compartmentalization of terrain. This will cause an increase in the number of lost rounds, adjustment rounds, and a reduced effect on target because a sheaf will spread out more as the slope angle increases. Destruction missions will rarely be worth the expenditure of ammo (if even possible at all). The opportunity to call and adjust fire in mountainous or compartmentalized terrain in peacetime should never be passed up. Expect an inexperienced FO to call some ineffective fire missions at first. Try to use suppression missions only, if possible.

Rocky terrain will increase the effect of fragmentation. A mix of airburst and quick fuse will produce a better fragment pattern. VT will have an increased rate of malfunction due to weather patterns. Mechanical time is better than variable time for airbursts.

b. Machineguns. When employing machine-guns, grazing fire becomes difficult to achieve due to the extremely compartmentalized terrain. Plunging fire is more common and needs to be mastered by gun teams. Indirect fire from the reverse slope will also be employed regularly in moderate terrain and use of firing tables to be mastered.

Leveling the tripod in expedient firing positions on moderate to steep slopes is difficult. Zero the T&E and align the weapon to the FPL/PDF if the slope is too steep to level the tripod with a canteen cup of water (aligning with gravity). If this method is used, indirect fire/use of firing tables cannot be used. Often the tripod cannot sit level in the 2 dimensional plane, which means the gunner will need to be skilled in the rapid and deft manipulation of the T&E in both traverse and elevation (i.e. on a steep slope firing to the front oblique valley floor).

When possible, dig into the hillside or build up, to level the gun in relation to the target with the T&E zeroed instead of in relation to gravity. It takes a lot of practice for a gun team to become proficient at setting in a gun that is ready to fire accurately on a moderate

to steep slopes.

When firing from a rocky position, use sand bags or pine bough to build a stable firing platform. For the M240G (or any medium machine-gun), the A-gunner's pack makes a great field expedient platform in rocks or snow.

In a fixed, rocky position, it is often impossible to dig in. So you must build up with rocks, gravel, dirt and timber. A gun position of only rocks is called a sangar. The dimensions are the same as for an earth and log position. Be sure to fill in pockets between large rocks with small rocks, gravel, etc. Also, try to place the rocks so that they overlap and interlock forming a solid wall.

The Heavy Machine-gun Platoon will have the same considerations for employment as the mortars. When going foot mobile, less guns and more ammo will normally be the call. Establish SOPs that anticipate this kind of employment.

Defilade and partial defilade positions can be used when firing across a compartment to the opposite ridge, but cannot be used to hit the valley floor because the round's trajectory will not drop enough if firing from a defilade position. Positioning for reverse slope defenses is no problem.

HMG Platoon displacement will take longer than in moderate terrain. HMMWVs displacement will be faster than foot displacement, but it will still be slower than on gentle to moderate terrain. The guns may also be regularly employed in terrain far from access to roads, and displacement of the guns and ammo may involve the use of rope systems. If moving by pack animal or foot, the commander must anticipate that the guns will be unable to maintain continuous support throughout the attack (such as during exploitation of success).

c. Anti-Tank Guided Missiles.
Dragons, being man portable, work very well in the mountains. Getting a stable platform in the rocks or on a slope is not hard. However, tracking a moving target on a steep slope at an oblique angle is difficult. These awkward positions can be practiced with the LET system in suitable terrain. Select a position that has minimum dust in both front and rear to reduce target obscuration and signature during firing. Be cautious of back blast reflection from steep or vertical terrain. When shooting over lakes, bogs, snowfields, etc., there is an increased risk of erratic missile flight.

TOWs are typically bound to MSRs. That will not be a major problem since their primary target (heavy armor) is also road bound. It is possible to break the system down and hump it to higher ground, but displacement and employment will be extremely slow. The TOW2 system will operate properly up to 10,000 feet in elevation. Above 10,000 feet, the air is not dense enough for the control features to steer properly (increased risk of erratic missile flight).

Capabilities and limitations of the Javelin and Predator in the mountains have not been

identified at this time.

7003. Other Small Unit Weapons. The infantryman in the mountains needs to be aware of the proper use of every type of weapon he might have access to.

a. Hand grenades. These are used to great advantage in mountain operations. Close combat among rocks and cliffs reduces the effectiveness of short-range rifle fire and increases the effectiveness of hand grenades, particularly when they can be thrown downhill. They are effective in wiping out machinegun nests and mopping up field fortifications. Personnel are cautioned about throwing grenades uphill in places where they are likely to roll back down on them.

b. Grenade launchers. Rifle grenades and/or grenade launchers can be very effective for covering dead space which exists between maximum hand grenade range and minimum light mortar range. Further, they are useful in the offense when mortar fires must be lifted due to proximity of friendly troops. Extensive practice in range estimation and grenade launcher employment must be focused on prior to deployment to the mountains.

c. Rockets. The AT-4 and SMAW are readily adaptable to mountain operations. These weapons are especially useful because of their portability. They provide a much-needed capability to defeat bunkers, weapons emplacements, and light-skinned vehicles and are readily convertible to defensive roles.

7004. Mines and Demolitions. MSRs are an easy target to mine, and so are trails. There are many cuts, fills, bridges and choke points to target. However, large surveyed minefields are difficult to put in. FASCAM is a possible choice for area denial mining in the mountains. Claymores are excellent for patrol base perimeter security.

Demolitions are very effective in making obstacles on MSRs, tunnels, bridges and railroads and can deny key areas to the enemy for extended periods. Demolitions can be used to initiate a rockslide. Non-electric blasting caps are preferred at high altitude due to the static electricity in the air. For demolition in rocks and rock soils, normal procedures apply except that fissures are often found which have to be well fitted and tamped with earth. A fougasse made with rock and explosives can be very effective if used on routes of approach in valleys.

Chapter 8. Tactical Considerations for Mountainous Operations

8001. General. Offensive actions by Marine units in mountainous terrain will lack the unity and ability to mass so characteristic of combat in rolling terrain. The configuration of the terrain tends to give the battle a piecemeal character and to divide it into isolated conflicts, difficult to control by senior commanders. Subordinate unit commanders maintain the initiative toward achieving the purpose of the operation, and must act in accordance with the commander's expressed intent. Defense constitutes the stronger form of warfare in mountainous terrain. The existence of numerous obstacles combined with the limited number of roads will impede offensive maneuver flexibility and heighten the element of surprise for the defender.

In an assessment written approximately halfway through the war in Afghanistan, General Yuri Maximov concluded:

> Surprise, resoluteness, and audacity play an especially important role in mountain operations. ... Even a small subunit can decide the outcome of the whole battle by unexpectedly maneuvering around a defender's flank or capturing a dominating height. ... in mountain combat the subunits should operate independently of the main body. This, to be sure, imposes additional responsibility on the commanders and subjects their subordinates to increased psychological stresses. ... We believe it of paramount importance to train the commanders of motorized infantry companies to control the fire of not only their own subunits but also of attached artillery, tanks, and aviation.

8002. METT-T. The small unit commander must consider the influence of mission, enemy, terrain and weather, troops and support available – time available (METT-T) when considering the situation.

(a) Mission. The mission is what needs to be done and should be always be combined with a commander's intent – why it needs to be done and what the final result desired is. The small unit leader will need to be prepared and encouraged to use his initiative and resourcefulness to take advantage of opportunities that arise and not be slowed by a desire to seek guidance from higher. Guidance comes from the commander's intent.

(b) Enemy. What is the enemies mountaineering capabilities? Is he indigenous to the operating area? Is he well organized and led? What is his mission? These are only a few of the questions that need to be answered prior to engaging the enemy. The Russians, with an army that was designed to defeat NATO, took nearly ten years to defeat the Afghan Mujahedin, who were a relatively disorganized group of guerillas. The Mujahedin lack of a strict, organized structure and execution of guerilla tactics gave them a great advantage in the mountains.

(c) Terrain and weather.

(1) Terrain. Control of tactically important terrain (passes, peaks, dominant flanking terrain, MSRs) is paramount to success. Terrain needs to become the primary consideration when determining how to destroy the enemy. The leader must do a detailed map study and possibly do a leader's recon prior to moving his troops into unfamiliar terrain. Natural obstacles and difficult relief features facilitate all

around defense in multiple layers at all heights. Generally speaking, mountainous country where there are high ridges and plateaus cut by deep valleys is best suited to mobile, small-unit operations. Larger units and vehicle convoys will be canalized in this terrain and become more vulnerable targets. Helicopters help to overcome the mobility problem and provide rapid deployment of troops when routes are dominated by the enemy.

(2) Weather. Use weather conditions to increase opportunities for surprise attacks. Exploit falling snow, blizzards, fogs, low cloud cover and natural night illumination. Imaginative use of weather obstacles may turn them into major advantages. Conducting offensive operations during severe weather conditions, however, restricts aviation support and increases control and reconnaissance problems. Furthermore, harsh weather requires that Marines train in a similar environment in order to gain confidence in their ability to operate equipment and employ weapons.

(d) Troops and support available. Mountains often do not permit use of desired friendly to enemy ratios against a defending enemy on initial attacks. Mastering the use of combined arms down to the fire-team level will often be the only way to defeat a well-entrenched enemy. Fire team: combine the use of the grenade launcher with the SAW and accurate fires from the M-16A2 to put the enemy in a dilemma. Company: combine the use of mortars and medium machine guns to allow an assault force to close in and destroy the enemy at close range. Any combined arms execution is difficult, dangerous and requires practice. Realistic training in this discipline must be accomplished prior to deployment to the mountains if the Marines are expected to be successful

Maximize the use of any trained Mountain Leaders in the unit. They are trained to select routes, negotiate difficult obstacles, and provide tactical advice for operations and to train the unit in the basics of military mountaineering.

(e) Time available. Often, operations will follow a strict timeline that will often be difficult to achieve because of a commander's underestimate of the difficulty in terrain. Ample time must be given for the completion of movements in the mountains and an appreciation for this can only be acquired by training in the mountains. Unforeseen obstacles and poor weather will combine to disrupt even the most flexible timelines.

8003. Offensive Operations. In all offensive operations, the seizure of dominant terrain features as intermediate and final objectives is often the final result desired of commanders. Every effort must be made to ascertain the surfaces or gaps in an enemy's defenses to include troop and weapons orientation, obstacles and fire support, and any concealed approaches. Often the terrain will be too compartmentalized to be completely covered despite the defenders best efforts. These gaps must be identified through use of probing attacks, reconnaissance and airborne observation. It may be necessary to conduct elaborate maneuver schemes to allow for a covert penetration of enemy defenses.

Roads and valleys make for the most convenient direction for an attack, but it is most likely the area where the enemy has concentrated his firepower. With this knowledge, the commander may choose to conduct a feint along the road in order to distract the enemy while the main effort conducts an approach along a discovered concealed route to the enemy's flank

Commanders must also be organized to counter the advantages afforded to the defender. Obstacle clearing teams (engineers, 0351's, etc.) should be near the front of an element in order to quickly dispatch with any obstacles. Security must first be established, as it should be expected that any obstacles will be covered by fire. Natural obstacles such as cliffs or rivers should be identified on the map and the commander should have his Marines task organized (assault climbers, TRSTs, medevac teams) to overcome these obstacles. Again, security must first be established.

When engaging the enemy, seek the high ground. Fighting uphill against the enemy puts the attacker at a disadvantage. Not only is it physically more difficult to climb uphill, but also the enemy will be able to lob hand grenades down on you and have a much better view of your forces. Every effort should be made to make a thrust for higher ground and then to sweep down on the enemy.

Ambush mentality. The most common tool for gaining the advantage is the ambush. The ambush combines the elements of surprise and mass to shock and disorient the enemy. The mountainous terrain provides all of the requirements for an ambush. Just remember, that the enemy will likely use the ambush as well, and aggressive security is the best way to uncover one.

Natural corridors of approach that are usually mined and easily defended are avoided. The enemy generally heavily defends peaks and ridges. Seizing the high ground may necessitate a frontal attack. Moving up the noses of subsidiary ridges can reduce the cost of such an operation. Restrictions imposed by the terrain usually limit the size of units employed.

Mission-type Orders. In rugged terrain, unusual and unexpected opportunities often present themselves to small unit commanders. If these advantages are rapidly and aggressively exploited, the whole action may be influenced. Small unit commanders are briefed on the overall picture and encouraged to take the initiative. Their orders are general to allow for initiative on the part of subordinates. The senior commander is quick to seize on advantages gained by subordinate units.

a. Attack. Flanking action is sometimes impossible, and units may be required to attack frontally.

Frontal daylight attacks in sectors where there are only very few and very narrow avenues of approach offer little chance of success. Such attacks are bound to be canalized and observed and meet organized fires. In addition, they are time consuming and give the enemy the opportunity to shift his reserves for a counterattack. When the attack is

launched quietly and stealthily at night and without preparatory fires, there is a greater chance of surprise without being exposed to observed and/or concentrated fire.

Simplicity of plan is the essence of a successful night operation. Such planning provides for continuous, effective control by the commander and for alternate action in the event that unforeseen developments arise. Characteristics of night attacks in the mountains include:

Comparative ease of maintaining direction (usually uphill).
Difficulty of maintaining control.
Slow movement.

The attack of a very steep position is frequently made easier by the great amount of dead space. Halts are never made on top of a ridgeline objective. The advance of units over crests is made cautiously, in a well-deployed formation. Assault elements continue to push the enemy toward the next objective or, if halted, dig in and reorganize well forward of the ridge crest. In case of a halt to reorganize, commanders of assault elements dispatch combat patrols to maintain contact with the enemy.

The crossing of a lateral valley and assault of a well-defended ridge are similar to the forcing of a river crossing. The purpose is to move a force across quickly and economically and establish a bridgehead to permit the crossing of the main body. This requires careful reconnaissance, coordination of supporting fires, and a carefully planned attack. Such an attack may be facilitated by night deployment or through extensive use of smoke. To move the entire force from the ridge into the valley before the next ridge has been secured is to invite disaster.

Vertical envelopment by helicopterborne units may overcome an enemy's defenses which ground forces would find extremely difficult to penetrate or outflank. Preparation for a vertical envelopment in the mountains involves the same considerations as in normal terrain. Such an attack is normally more difficult in mountainous areas because of the scarcity of landing sites and the reduction in the lift capability of the helicopters.

b. Supporting Weapons. Infantry heavy weapons and artillery forward observers closely follow advancing elements to commanding ground in order to give continuous support to the attack.

Because of the difficulties in ammunition supply, a percentage of artillery and mortar ammunition should be retained for close support of the assault and for breaking up counterattacks.

c. Use of Smoke. The use of smoke in various phases of mountain operations assumes a high degree of importance. Smoke may be used in daylight frontal attacks, stream crossings, withdrawals, and for marking and identifying positions, targets, and objectives.

d. Exploitation and Pursuit. Local success is exploited immediately and vigorously; e.g., by employing reserves for flanking attacks on adjacent enemy points of resistance,

by seizure of enemy communication centers, and by cutting off the retreat of isolated enemy forces. Artillery covers conceivable escape corridors to the limit of its range. Frequent forward displacement of artillery is time consuming. They can be moved forward on a road parallel to the axis of advance or penetration. Displacement sites must be surveyed and vehicle traffic must be controlled. Participating aircraft, when available, are called upon to attack retreating columns in maximum strength.

Attacking in the mountains is difficult work, and assault elements are generally too tired to be used effectively in the pursuit. For this reason, reserve elements are used in pursuit.

8004. Defensive Operations. The mountainous environment strongly favors the defense.

a. Advantages. When the Marine unit assumes the defense in a mountain environment, it has the following advantages:

Use Dominant Terrain. Dominant terrain provides superior observation and firing positions. The slopes and other terrain features impose difficulties on the attacker. There are zones that are either impassable or extremely difficult for the enemy to negotiate; however, no area should be considered impassable.

The Enemy has a Limited Opportunity to use his Mechanized Capabilities. The lack or scarcity of roads, the steep slopes and other rugged terrain features place restrictions on the enemy's use of tanks and other mechanized vehicles and renders them vulnerable.

Opportunity to Exploit Engineer and Artillery Capabilities. Advantages derived from the terrain may be increased to a great extent by manmade obstacles combined with long range observed artillery fire and aerial bombardment along the attacker's route of advance. A small number of well-placed demolitions are often sufficient to stop enemy movement on a large section of the front for a considerable period of time.

Great Opportunity for Deception Operations. Mountainous terrain assists the unit in a defensive position in deceiving the enemy as to its strength, purpose and disposition.

Opportunity to Effectively Use Reserve Elements. Although it is difficult to move reserve elements, the defender can usually accomplish such movement more rapidly than the attacker. This is because the defender has more intimate knowledge of the terrain, time to prepare a network of lateral trails, and its troops are ordinarily less fatigued than those of the attacking enemy.

Great opportunity to Fight Delaying Actions. Delaying actions are particularly effective in mountains and can be accomplished by a much smaller force than is ordinarily needed. Roads and trails can easily be made impassable for a time by creating rockslides and blasting craters on the steepest slopes, in narrow passes, and in general, where obstacles cannot be bypassed or easily removed.

b. Disadvantages. When the Marine unit assumes the defense in mountainous terrain, it is confronted with the following disadvantages:

Use of Supporting Fires. Compartments make it difficult or impossible for fire support elements to cover the whole front or to mass all fires.

Counterattack by Reserve Forces. It is usually difficult to maneuver centrally located reserve units to execute counterattack plans.

Fields of Fire. Grazing fire is often impossible in rugged terrain.

Initial Organization of the Defense. Mountains with wooded slopes, and moderately difficult cliffs, may enable the enemy to make surprise attacks at several points. Difficulty in digging necessitates a longer time for organization of positions.

Possibility of Bypass. There is a greater possibility of being bypassed and cut off by the enemy.

Excessive dead space. It may be impossible to cover every possible concealed avenue of approach, so sentries must be especially vigilant to watch their fronts.

c. Selection of Positions. The selection of defensive positions is governed by the necessity to:

Stop the enemy at or forward of the designated area.

Barring routes of penetration that the attacker may use.

Protect routes of communication for the defense. Especially important are crossroads, bridges, and lateral roads that may be used by reserve elements of the MAGTF.

Provide adequate security to flanks and, where possible, protect the flanks by placing them against deep ravines, vertical cliffs, or other areas that are difficult to penetrate.

Provide security for all areas of the front, no matter how inaccessible to the enemy they may appear.

Establish an all-around defense, particularly since terrain considerations may necessitate the organization of defensive positions on successive ridges.

Form a system of mutually supporting positions that defend all key terrain features in the defensive area.

Establish a lateral communications capability between mutually supporting groups.

Establish an effective observation of all hostile approaches in order to have early information of enemy movement and troop concentrations.

Establish local security (OP/LPs/Mountain Pickets) and aggressive patrolling in all directions to minimize the chance of the enemy gaining surprise.

The use of a preponderance of automatic weapons is of greater importance in mountainous terrain than in normal defense situations. Bare ridges can often be better covered by automatic fire from an adjacent ridge than from any position on the ridge itself. Ravines are covered by mortar fire and/or blocked by antipersonnel mines, barbed wire, or other obstacles.

When occupation of a forward slope subjects units to heavy observed fire, it may be best to leave only a combat outpost on the military crest and place the forward edge of the battle area (FEBA) on a favorable reverse slope. Such a location for the FEBA puts the enemy in an unfavorable position for observation and limits the effectiveness of his fires and maneuver. A reverse slope defense gives the defending weapons favorable positions that are protected from observed artillery fire. The more difficult the defense of a position, the more important it is to have active patrols well forward to discover the dispositions of enemy forces.

d. Counterattack. Counterattacks, when launched down a descending slope, can be developed quickly with relatively little physical exertion. When the slope is under enemy observation, a deep counterattack is impracticable. When it is carried out on a reverse slope or directly behind a topographical crest immediately following a stubborn defense of the crest, it may surprise the enemy before he has been able to establish himself.

e. Withdrawals. The usual difficulties encountered in any withdrawal are increased when such an operation is necessary in the mountains. Pursuing enemy troops can infiltrate friendly units if they advance rapidly on routes parallel to the route of withdrawal and emerge along lateral routes on the flanks or in the rear. Also, limited trails and road nets hamper the withdrawal of equipment and supplies.

When a withdrawal becomes necessary, the unit leaves behind delaying detachments supported by a system of obstacles to cover the most critical crossroads and lateral routes. By taking advantage of strong natural positions and by providing the detachments with a preponderance of automatic weapons, the numerical size of such detachments may be held to a minimum.

The withdrawal of the forces engaged in the various terrain compartments is closely coordinated to prevent the cutting off of some units or a sudden breakthrough by the enemy.

Artillery and aircraft concentrate their fires and bombardments on points where the enemy must pass through narrow gaps or over obstacles.

8005. Engineer Operations.

a. Engineer Reconnaissance. The combat engineer is an excellent asset to perform reconnaissance since he possesses the expertise on what to look for in order to support the ground combat elements in mobility, countermobility, survivability and general engineering. Because of the extremely limited number of MSRs and routes for vehicles through the mountains, the engineers' ability to create obstacles may be his greatest asset. The Engineer platoon can create obstacles on a few key pieces of terrain and thereby allow the battalion to effectively control access in and out of its TAOR.

b. Engineer Reconnaissance Missions. Accurate route, zone, and area reconnaissance operations are crucial to an infantry battalion's success in a summer mountainous environment. The engineer reconnaissance should include natural and man-made obstacles, route conditions, critical terrain features, conditions of cross-country trafficability, and all towns, woods, fording, and stream crossing sites.

c. Relationship with Engineer Missions. The reconnaissance mission relates not only to the engineer mobility mission, but also to the countermobility, survivability, and general engineer missions.

Provide mobility assessment through proper route reconnaissance and accurate information on enemy obstacles/barriers.

Provide countermobility by proper barrier planning and establishing target/obstacle folders and target analysis.

Enhance survivability by proper emplacement of friendly forces.

Conduct general engineering by locating utility assets, water points, and identification of local construction points.

d. Obstacles. The objective of enemy-installed obstacles is to delay moving forces, canalize them, and create time for concentration of destructive fires. Although obstacles themselves may not be destructive like mines, many will be booby-trapped. Threat obstacles must be rapidly overcome to prevent excessive casualties to friendly forces.

e. Counter-obstacle Operations. Success occurs during counter-obstacle activities when friendly forces successfully reach the objective beyond the obstacle. Enemy forces around and beyond the obstacle are the objects of attack, not the obstacle itself. Overcoming an obstacle without significant loss of time, personnel, and equipment is achieved through early detection of obstacles. Currently, counter-obstacle detection is primarily limited to visual ground and air reconnaissance or actual encounters. Remote imagery is another method of early obstacle detection. Most obstacles, other than minefields, are easily detected from the air. The maneuver commander will determine whether the obstacle will be bypassed, or breached/reduced. If the decision is to

breach/reduce, the mission falls upon the combat engineer. Breaching is accomplished by using manual, mechanical, or explosive force against the obstacle.

f. Non-explosive Obstacles. The following are examples of non-explosive obstacles and methods of reduction or breaching. The focus is on possible obstacles that may be encountered in a summer mountainous environment.

Note: Although demolition techniques are listed in this chapter, specific demolition calculations and procedures for employment are covered in FM 5-34 and FM 5-25.

Wire. Wire obstacles are used mainly to hinder movement by small numbers of troops and usually supplement other obstacles. The preferred breaching technique is through the use of bangalore torpedoes or linear demolition charges. Although manual means to breach the obstacle such as wire cutters, wooden planks, and engineer stakes can be used the possibility of hidden mines and booby traps ads additional risks.

Bangalore torpedoes. Place the ordnance as close to the post/posts as possible to get optimum results.

Log crib. An earthen filled log obstacle across roads or trails can further decrease trafficability in an already heavily wooded area. The preferred breaching techniques are mechanical removal, destruction with demolitions, or a combination of both.

Destruction with demolitions. 30 – 40 pound charges will be buried within the crib to 2/3 the obstacle height and at 8' intervals. All wire should be cut on the log crib prior to blowing the charge to reduce fragmentation.

Mechanical removal. The D7 bulldozer or ACE (Armored Combat Earthmover) will primarily be used to remove the obstacle. The TRAM, SEE (Small Emplacement Excavator) tractor, or civilian equipment can be used as well with lesser results.

Log Post. Destruction with demolitions is the preferred breaching technique. C-4 charges, size calculated from the post diameter, can be attached to the base of each post or, for a cleaner cut, a ring charge can be used.

Log Wall. Often back-filled, the preferred breaching technique is with demolitions. If time permits the charge should be buried or tamped, although a large surface shot might work.

Abatis. An obstacle made from felling trees across a road or trail. Removal and clearance depends on the characteristics of the fallen trees and the total depth of small diameter can generally be forced through with mechanical pushing effort. Where this is not possible, a combination of manual or explosive breaching and mechanical force is recommended.

The fallen trunk of the tree should be separated from its base with saws or explosive charges. The remaining timber is then pushed or winched from the roadway.

g. Creating Obstacles. Constructed obstacles are those reinforcing obstacles that are built by Marines and machinery, generally without the use of explosives. The mountainous environment offers an unlimited amount of resources to construct many different types of obstacles. Many natural obstacles already exist and need little to no reinforcing. The following are some of the different types of obstacles that can be constructed relatively easy in a mountainous environment:

Wire. Single, double, and triple strand concertina entanglements are easy to employ and retrieve and can be reinforced with mines and booby traps as needed. All three are designed to hinder foot mobile forces and are usually tied into other existing obstacles.

A knife rest is a portable/mobile obstacle that is constructed with logs, wire, rope, and concertina. Primary use is for temporary roadblocks.

A concertina roadblock is constructed of 10-15 rows of concertina laid across the road reinforced and strengthened with barbed wire and e-stakes. A very effective obstacle against foot mobile forces and light vehicles.

Log Obstacles. There are many different types of log obstacles that can be constructed using local materials. Log obstacles are effective when the lack of a bypass forces the enemy to breach them. Although they are time and labor intensive, locations for their employment are limited; they do not require much logistic support. They can be constructed entirely by hand. Log obstacles can and should be used in conjunction with other obstacles to increase their stopping power. Log obstacles include hurdles, cribs, and posts.

Log Hurdles. Logs greater than 10” in diameter should be used. They are not intended to stop tanks, but will cause them to slow down.

Log Cribs. Rectangular or triangular in shape. Strengthen by filling them with earth. It is preferable to obtain the earth by digging a shallow ditch in front of the obstacle.

Log Posts. Among the best anti-vehicular obstacle because each post presents a breaching problem. This obstacle is gear and personnel intensive as well as being very time consuming.

Abatis. An effective obstacle against tanks and other vehicles in a heavily wooded are with few roads or trails; the abatis can be constructed relatively fast by use of chain saws organic to the combat engineer platoons.

Chapter 9. Communications in the Mountains

9001. General. Mountainous terrain presents unique problems for communications. Detailed preliminary planning supported by map and terrain reconnaissance is essential to all phases of reliable communications in mountain operations. The physical location/ placement of equipment becomes extremely critical in high mountain areas. Infantry operations in the mountains may be characterized by amphibious employment of companies and battalions landing in canalized areas, which may be beyond the range of mutual support, and, at considerable distances from higher headquarters. Terrain may restrict the movement of a unit or units and it is important to maintain dispersion. Because of this dispersion, a greater use must be made of radio communications at a longer range. One of the keys to success in a combat situation is reliable, secure, rapid, and flexible communications system. This is especially true in the mountainous environment, where the infantryman faces the problems of survival, and mission accomplishment. Therefore, it is important that the infantryman understand the effects of the mountains on communications, and the procedures he can use to counteract the adverse effects.

For example, ridgelines and other mountainous terrain features can prevent one radio operator from contacting another, who is only 1-2 km away. One of the operators is going to have to seek higher ground. Rocky soil found in most mountain terrain can cause greater difficulty in driving ground rods and guy wire stakes. Imagination is going to be required in order to raise an OE-254 on rocky ground.

9002. Radio. Due to high mountains or large tree masses, radio transmissions should be planned to be direct line of sight. Terrain obstacles will have to be effectively overcome by careful selection of retransmission/relay sites and airborne repeaters.

(1) These retrans sites should not be on the geographical summit as they will be skylined and quickly identified by the enemy. Instead, place the sites on the military crest on the slope facing where the majority of forces are. The retrans sites will need to be manned by a security force. An ML or AC may need to accompany them in order to get them onto difficult ground. The security force should bivouac away from the antenna, as it may be identified and targeted by fire support assets. The radios should be fortified against impacts by either digging them in or by covering them up with a stone barrier.

(2) If an “Ant-farm” is created for the battalion COC, remote it as far as possible from the actual CP. This will prevent the enemy from targeting the CP directly.

9003. Wire. Wire is one of the most reliable means of communication. In rugged mountains wire will be extremely difficult to install and maintain.

9004. Physical Means. Visual and sound signaling assumes increased importance in mountain operations. The long lines of sight from high locations present excellent opportunities for use of semaphore, blinkers, lamps, flags and mirrors. Also, sound carries greater distances when in high mountain ranges.

9005. Messengers. Messenger communications in mountains may be slowed due to poor roads/inadequate road systems and other difficult terrain obstacles. One-half kilometer per hour is considered fair speed for trained messengers in rough terrain. Messengers must be trained to depend on natural terrain features and manmade landmarks for orientation. Messenger service is very secure, cannot be jammed and is able to handle large volumes of traffic.

9006. Load Considerations.

QUANTITY	EQUIPMENT	WEIGHT
One	PRC 119 with spare battery	21 lbs.
*One	OE-254 antenna	45 lbs.
One	DR 8 with handle 1/4 mile reel of wire	18 lbs.
One	MX 306 1/2 mile wire	25 lbs.
One	RL 159 with handle 1 mile reel of wire	73 lbs.
One	TA 1042 or 838 field telephone	10 lbs.
One	PRC 104 with spare batteries	25 lbs.
One	PRC 68 with spare battery	4 lbs.
One	PRC 113 with spare battery	22 lbs.

*The weight of the OE - 254 antenna can be reduced to 20 pounds by not carrying the 12 metal mast sections. Parachute cord (70 feet in length) must be carried so that the OE - 254 can be tree-topped.

Methods of reducing the communication equipment load on the individual Marine are:

(1) Log trains. Utilize the log trains to provide re-supply of batteries, wire, preventive maintenance material, and maintenance support for the interchanging of equipment that is inoperable.

(2) Spread load communication equipment between the Marines of each command group tent team.

Annex A. Warfighting Load Requirements

The warfighting load requirements have been developed as a guide for commanders when planning operations in the mountains. Commanders will decide, depending on the mission and terrain, which equipment load Marines will carry.

a. Basic Uniform Requirements. Marines operating in mountainous terrain will generally wear the standard issued utility uniform. However, due to the wide range of temperatures, and sudden changes in weather in the mountains, Marines will find the need to be continually adding and removing layers. The amount of clothing worn may vary depending upon the severity of the weather, the activity level of the Marine, and the individual metabolism of the Marine. Every person in that unit should still maintain the same outer camouflage layer as dictated by the Commander.

b. Pocket Items. As part of the basic uniform, each man will be required to have in his possession, at all times, seven required pocket items. These seven items should be carried in the pockets of your utility uniform:

(1) Pocketknife
(2) Whistle
(3) Pressure Bandage
(4) Chapstick and sunscreen
(5) Sunglasses
(6) Survival Kit and rations (fire starting material, signaling material, food gathering material, water procuring material, 1st aid, shelter material, and some high energy, lightweight snacks.)
(7) Notebook with pen/pencil

Some additional items that should be carried in your pockets at all times:

(1) Contact gloves
(2) Paracord (10 meters)
(3) Flashlight with tactical lens and spare batteries
(4) Chemlights

c. Assault Load. The Assault Load is equipment in addition to the basic uniform requirements, and is carried in the load-bearing vest (LBV), butt pack and pack system. This is the equipment carried for short duration missions such as security patrols or during the final assault phase. It is carried at all times when you are away from your bivouac site.

(1) An extra insulating layer (Field jacket liner, woolly pully, etc.)
(2) Protective layer (ECWCS parka and trousers)
(3) LBV with 2 quarts of water and first aid kit
(4) Helmet
(5) Rations for the time away from your bivouac site
(6) Cold weather hat or balaclava
(7) Individual mountaineering gear
    a. Sling rope

b. Carabiners
c. Rappelling Gloves

(8) Specialized mountaineering equipment
(9) Mission essential gear:

*T/O weapon with accessories (sling, magazine, cleaning gear, bayonet/K-bar, and basic allowance of ammunition)

*Extra ammunition, demolitions, and pyrotechnics as the mission dictates.

*Optical gear (binoculars, night vision devices, etc.)

*Communication equipment (field phones, spare batteries, etc.)

*Navigational equipment (map, compass, GPS, etc.)

d. Combat Load. The Combat Load is the equipment carried for longer duration missions such as movements to contact. It is carried in the pack and consists of essential gear required in the event of an unplanned bivouac and the gear required to conduct medevacs. The following items are in addition to the items already being carried in the Assault Load.

(1) Sleeping Bag w/ bivy bag
(2) Isomat
(3) Individual/squad stove (Whisperlite, Peak1, etc.)
(4) Fuel bottle w/ fuel
(5) Thermos
(6) Poncho (for expedient shelters or medevac purposes)

NOTE*:* If the gear list dictates that each man carries the Assault Load, then 1 man per squad will also bring the Combat Load items. These items may be spread loaded throughout the squad to prevent over-burdening 1 man with extra weight.

e. Existence Load. The existence load is any extra gear that is required that can be brought up to the forward combat elements once the situation allows. Ideally, each fire team packs their excess gear in one seabag, and it comes forward on the log train. It includes, but not limited to:

(1) Extra insulating layers
(2) Extra socks
(3) Extra glove and mitten liners
(4) Toiletries
(5) Sewing Kit

f. Packing Considerations. Because most Marines are familiar with how to pack a pack, these are general guidelines only.

(1) When not wearing your protective layer or insulating layers, keep them handy at the top of the pack. When taking a break during a movement, you will be able to quickly don a layer to prevent getting chilled.
(2) Keep your stove and fuel bottle in the outside pockets of your pack. They may leak and soak your equipment with fuel if stored inside your pack. Ensure food and fuel are not stored together.

(3) Keep the climbing rope in the rope bag. This will reduce the rope's exposure to petroleum products, ultra-violet light, cuts, and abrasions.
(4) Place heavy items (such as the radio) in the middle of the pack, close to the back.
(5) Do not have extra gear strapped to the pack and hanging off of it, if possible. This gear will catch on vegetation and get lost. If you can't fit everything in the pack, you have too much stuff!
(6) Get proper instruction on how to fit packs, such as the Vector, LCS-88, and MOLLE. These packs have suspension straps that customize the fit of the pack to the wearer's body frame.
(7) If possible, the Company Gunny should have pack repair materials (extra shoulder straps, belts, and sewing material) in order to maintain serviceable packs when it is not possible to survey them.

Annex B. Marine Assault Climber's Kit (MACK)

TABLE OF CONTENTS

BOX #1		
ITEM	QUANTITY	MINIMUM BREAKING STRENGTH
CARABINER, ALUMINUM NON-LOCKING	136	4,400 lb.
CARABINER, STEEL LOCKING "D"	40	7,000 lb.
NUT, WEDGE, WIRE (set of I each size I- 1 2)	4	550 lb. To 2,800 lb.
NUT, HEXCENTRIC (set of I each size 1-10)	4	2,800 lb.
CAMMING DEVICE, 4 CAM (SMALL) (set of I each size 1-5)	4	2,600 lb.
CAMMING DEVICE, 4 CAN (LARGE) (set of I each size 1-4)	4	2,400 lb.
PULLEY,RESCUE	8	5,000 lb.
PLATE, BELAY	8	
ASCENDER	8	1,500 lb.
TOOL, NUT	8	
HARNESS, CLIMBING	8	3,500 lb.
BAG, ROPE	8	
ROPE, DYNAMIC	4	5,400 lb.
ROPE, STATIC	4	6,500 lb.
RUNNER, SPECTRA 2"	8	5,500 lb.
RUNNER, SPECTRA 6"	8	5,500 lb.
RUNNER, SPECTRA 12"	8	5,500 lb.
RUNNER, SPECTRA 24"	8	5,500 lb.
RUNNER, SPECTRA 48"	8	5,500 lb.
GEAR, SLING ADJUSTABLE	2	5,500 lb.
CLIMBING LADDERS	2	1,322 lb.
ROPE, PRUSSICK 7' (7mm)	8	2,200 lb.
ROPE, PRUSSICK "TEXAS KICK" 22' (7mm)	8	2,200 lb.
EIGHT RING	8	6,000 lb. (brake strength- 2Kn)
18' TUBULAR NYLON RUNNER, 1"	1	6,000 lb. (brake strength- 2Kn)

BOX #2		
ITEM	AMOUNT	MINIMUM BREAKING STRENGTH
ROPE, DYNAMIC	5	5,400 lb.
ROPE, STATIC	15	6,500 lb.

BOX #3		
ITEM	**AMOUNT**	MINIMUM BREAKING STRENGTH
ROPE, DYNAMIC	6	5,400 lb.
ROPE, STATIC	8	6,500 lb.
CARABINERS, STEEL LOCKING “D” 85’s	200	7,000 lb.
CARABINERS, STEEL LOCKING “D” 82’s	200	3,300 lb.
ROPE, PRACTICE COIL 25’	16	5,000 lb. (approx.)
ROPE, BAG 165’	16	

BOX #4		
ITEM	AMOUNT	MINIMUM BREAKING STRENGTH
ROPE, STATIC 300’	9	6,500 lb.
WEB RUNNER 7’	50	4,000 to 4,500 lb.
PRUSSICK CORD 7’ (7mm)	30	2,200 lb.
ROPE, PRUSSICK CORD 22’ (7mm)	10	2,200 lb.