MOUNTAINEERING

MOUNT McKINLEY NATIONAL PARK
ALASKA



EXPEDITIONARY MOUNTAINEERING

It cannot be overemphasized that Mount McKinley, Foraker, Russell, and comparable peaks are far more dangerous and difficult than climbing high peaks further south. Each is a major expedition into arctic conditions at high altitudes with required climbing time commonly exceeding 30 days. Superior mountaineering skill, stamina, conditioning, equipment, and ability to survive in severe arctic conditions are essential. *Experience has shown that even these essential qualifications do not guarantee safety or success.*

Park authorities are vitally concerned with the safety of climbers within the Park and are responsible for fostering and enforcing safe mountaineering practices. The following regulations have been developed and MUST BE COMPLIED WITH by expeditions planning climbs of Mount McKinley and Foraker. Keep in mind they are recommended for other climbs in the Park.



PHOTO BY WILLIAM RUTH

MANDATORY REQUIREMENTS

REGISTRATION: The leader of the expedition should register with the Superintendent at least two months in advance. Each climber must submit a statement of previous climbing experience, listing major ascents and general mountaineering background, along with a physician's statement of his current fitness for the climb. Personal registration and expedition forms should be filed as early as possible with the Superintendent of Mount McKinley National Park. This will provide an opportunity to evaluate the groups's capability and offer advice and counsel. These forms are available from the Superintendent's office. Name your expedition and use it when filling out the expedition application as well as on all correspondence.

RADIO COMMUNICATIONS: Each expedition on major peaks must carry a two-way radio capable of reaching another manned station. This manned station must be capable of maintaining contact with Park Headquarters. There is a limited source of radios so these arrangements should be one of the priority pre-climb goals.

CHECK-IN AND CHECK-OUT: The party leader or his designee must report to Park Headquarters by phone or in person just prior to departing and upon returning from the climb.

SCIENTIFIC EXPEDITIONS: Expeditions organized primarily for scientific purposes should contact the Park Superintendent for special information. Applications for permission to conduct such projects should be received at least 90 days before the proposed work is to begin to assure sufficient time for review.

COLLECTOR'S PERMITS: A Collector's Permit is required of all persons intending to take specimens from within the Park. Granting of the permit in no way gives scientific status to an expedition.

AFTER CLIMB REPORT

The Superintendent requests a post-climb report of each expedition. A daily account of weather, equipment failures, camp locations, accidents, route variations, unusual incidents, and maximum elevation reached by each climber are suggested inclusions. This information updates the mountaineering history records, aids future climbers, and keeps the National Park Service aware of current activities.

SUGGESTED GUIDELINES

The following points have been helpful to many previous expeditions:

THE PARTY: A party should have at least four members. A large party is better as it provides greater inherent strength and self-rescue capability. The leader must have extensive mountaineering and leadership experience. The qualifications of each party will be evaluated on individual experience. Generally more than 75% of any party should be relatively experienced in mountaineering to use the less technical Muldrow and West Buttress routes on Mount McKinley. All members should be highly skilled if using more difficult routes.

Experience has shown that parties composed primarily of individuals who have not climbed together tends to be a weak climbing group. Such mail-order expeditions will be discouraged.

The expedition leader must know the physical qualifications, physical condition, and the experience background of each team member. The leader must be prepared to verify claims made by each member on his application material.

EQUIPMENT INSPECTION: A Park official or designated representative can inspect the expedition equipment if the party desires a final check.

EQUIPMENT RECOMMENDATIONS: These are minimum suggested equipment items for a party of four. Everything should be in good condition.

☐ **Boots:** The military vapor barrier Korean boot has an outstanding record of frostbite prevention. Other footgear which may be acceptable, depending on conditions, include the double insulated climbing boot (such as the Lowa, with extra liners, or the Galibier) or the insulated climbing boot used with an insulated overboot. A felt boot is sometimes carried for a second pair and used in cold, dry conditions. Conventional leather boots are *unsuitable* for the extreme conditions on the higher peaks. Please do not take this information lightly. Very severe conditions will be encountered at higher altitudes even in summer. If skis are used, ski boots should be a double insulated variety.

Out of 114 climbers on McKinley and Foraker during 1961-63, 14% were hospitalized for frostbite, primarily of the feet. Of the 67 who wore the military Korean boot, *none* were frostbitten. But 33% of those wearing the civilian Korean boot, 83% of those wearing standard leather boots with no overboot, and 7% of those wearing insulated double boots were frostbitten and hospitalized. (Avoiding Frozen Feet — Cold Weather Footgear AAJ, 1965.) Korean or "K" boots are considered best for most people.

☐ **Snowshoes or Skis:** One pair per person, with complete repair materials. Skis should be used only by experienced ski mountaineers. Snowshoes must be well made for hard use. They are frequently broken. Extras should be considered.

☐ **Stoves:** At least two, of proven efficiency at high altitudes and extreme cold. Some parties have had trouble in very cold weather with a popular disposable gas-cartridge model, especially when domestic cartridges were used. This should be looked into carefully. Fuel consumption varies, but allow for the worst possible conditions. Extra fuel is cheap insurance.

☐ **Ice Axes:** *One per man plus at least one spare for the party.*
They are easily lost during falls into crevasses.

☐ **Crampons:** One pair per man, of proven quality, carefully prefitted to the footgear to be worn. A spare pair of adjustable crampons is advisable for each party.



PHOTO BY RICHARD STENMARK

☐ **Snow Shovels:** *At least two.* They are essential for leveling campsites, digging snow caves, digging out buried tents, and have even been used in some places to cut a route. Small, lightweight snow shovels commonly sold in mountaineering supply houses are almost useless under McKinley conditions. They lack both sturdiness and capacity. High (approximately 14" x 18") aluminum grain-scoops which weigh only about 3 lbs. and can be purchased at many hardware stores have proven extremely valuable and are highly recommended.

☐ **Snow Saws:** *At least two.* They are essential for building igloos, snow caves, or walls of snow blocks. They should be extremely sturdy, with a large handle, a stiff blade, and large teeth.

☐ **Tents:** Of expedition quality. Extra poles and repair materials are important because of the frequency of damage in storms. Beware of *waterproof* tents such as the old Army mountain tent; they are unsuitable because of possible suffocation by CO_2 poisoning and excessive condensation. Light, water repellent tents with impervious floors and frost liners are most desirable. A rain fly may be important at low elevations. There should be shock absorbers in the tent guy lines. *Remember that winds in excess of 80 MPH are common and may last for many hours or even days. They may be accompanied by temperatures of - 40° or colder. In such conditions, failure of the tent is disastrous.*

The large high-topped 3 or 4 man tents are preferred by experienced expedition climbers because they are less susceptable to drifting over and are infinitely more comfortable and convenient to live in. It is possible to dry damp clothing in a larger tent where it is extremely difficult in a two-man type. In large tents and igloos it is also possible to conserve the body heat of several climbers by sleeping under a common tarp cover. However, even the best and largest tents will not provide comfort and rest during severe wind storms common on Mount McKinley. Tent failure is likely and the noise of flapping tents results in extreme nervous tension. *Igloos or snow caves should be used wherever possible when these conditions exist.* Each climber should have experience in building such shelters *before* attempting Mount McKinley. Additional practice may be profitable at lower elevations.



PHOTO BY HANK NOLDAN

☐ **Sleeping Bags:** *Of expedition quality.* They should be of the mummy type with 3 lbs. or more of down, and with a water-repellent cover. Extra insulation beneath is essential. Most climbers prefer foam pads of polyethylene, urethane or ensolite or caribou hide pads. Adequate sleep is essential at high altitudes. Do not economize on weight here.

☐ **Rope:** At least one 120 foot x 3/8 (or 7/16) Goldline, Perlon, or mountain-lay nylon type for each two climbers, with a spare for crevasse rescues and miscellaneous purposes. Manila, polyprophylene, or material with little stretch is desirable for fixed ropes.

☐ **Sun Goggles:** *Proven quality, very dark, two pair per person.* Extra amber lenses are useful in flat light, but are totally inadequate for general use as are sun glasses with open sides. The glare is often remarkably intense. Quality sun cream is essential.

☐ **Medical Kits:** *One complete kit should be available to each segment of a party.* It should include sun oil, zinc oxide, medicated skin cream and drugs such as morphine and antibiotics for use in an extreme emergency with carefully written instructions on their use. It is of greatest importance that expedition members consult at length with a physician about field treatment of common emergencies. These are mentioned on the Physician's Certificate (M-87-b).

☐ **Cooking Utensils — Mess Gear:** As needed. Some thought should be given to including a large cooking pot.

☐ **Artificial Light:** A candle lantern or some other form of light should be taken. Remember that the output of cold batteries is drastically reduced.

☐ **Matches:** In waterproof containers. Windproof matches are available.

☐ **Repair Kits:** Should contain wire, twine, pliers, *patching material for Korean boots*, repair materials for bindings and tents, extra stove generators or miscellaneous parts. Plan according to your equipment. Think Ahead.

☐ **Signal Devices:** Smoke flares, signal mirrors, fuses, colored panels, rocket-type flares.

☐ **Trail Markers (Wands):** *Adequate for the proposed route. At times it may be impossible to see markers only 100 feet away.* Trail markers are essential for safety, especially during bad weather. Approximately 350 wands spaced about 250 feet apart, will mark most of a route from 6,500 feet to the summit of Mount McKinley. Five-foot wands may be desirable for marking caches and in deep snow below 11,000 feet. For safety, wands should be not much more than a rope-length apart when high on the mountain.

☐ **Radio:** Two-way radio capable of communication with an outside station, with several sets of batteries. Line-of-sight portable transceivers weighing two to three pounds and capable of reaching 24-hour telephone operators in Anchorage and Fairbanks from altitudes above 9,000 feet have been used successfully by several expeditions. These may be rented in Anchorage or Fairbanks for about $50.00 to $70.00 per month plus a refundable $100.00 deposit.

☐ **Food:** *Adequate to last for the expected duration of the climb plus a large reserve for unexpected emergencies.* Most expeditions have figured on 4,000 to 5,000 calories per man-day. Some groups have been out *more than two weeks longer than expected* because of bad weather.

To Protect Food: When relaying loads, be careful to cover food caches from ravens. More than one expedition has come to grief from the depredations of these birds. At lower altitudes, grizzly bear and wolverines have been known to destroy caches near the edge of glaciers.

☐ **Clothing:** Adequate for the severest arctic conditions. The best is necessary. Include a down parka, down pants, wind parka, wind pants, plenty of woolen socks, head face mask, sun hat, one pair light gloves, and one pair insulated mittens (long sleeve).

Extreme conditions can be expected on Mount McKinley *at any time of year.* It is difficult for those inexperienced in this degree of cold to comprehend the problems involved in simple survival. Strong windstorms can hit the upper part of Mount McKinley at any time, with little warning, and can stop the strongest party if they are not sheltered. However, the temperatures encountered between 7,000 and 20,000 feet may vary as much as 120°. Temperatures may range from 70-80° above to as much as 50° below Fahrenheit. The effect of wind increases these extremes. Protection from heat and glare are also important. Lightweight, wind-resistant clothing in layers allows for adjustments to be made according to conditions. Down clothing is especially good in the coldest weather. A parka hood is essential and a fur ruff is recommended. Woolen trousers with closeable cuffs worn with woolen or insulated underwear and light wind-pants are generally used. Two wool shirts or sweaters should be brought. Headgear must provide good ear protection. Mitts should be leather faced, very roomy, with thick removable woolen liners worn over light silk or cotton gloves. Down mitts are superior for severe cold. Extra mitts should *always* be carried.

Socks should provide thick, *loose* insulation. Several extra pairs should be carried. Only light socks are needed in good "Korean" boots, but will quickly become soaked and should be changed frequently. Down filled "booties" have been praised by most expeditions for wearing in the tent and sleeping bag.

Parties approaching from the north during the summer months will need headnets, a good supply of excellent mosquito repellent and rain gear.

GENERAL INFORMATION

AIR SUPPORT: Except in extreme emergency, air drops and landings are not permitted within the National Parks and Monuments without advance written permission of the Superintendent. (Code of Federal Regulations, Title 36, Chapter 1, Part 2, Paragraph 2.2(b).) Generally, permission will not be granted except where such support is necessary for bona-fide scientific research or is positively essential for safety.

CLIMBING: Snow conditions and weather for climbing major peaks are usually best in April, May and July. Colder minimum temperatures commonly occur in April and May. Weather in June is often good, but snow conditions on the glaciers are often very bad and avalanche conditions are sometimes severe.

APPROACHES: The usual point of departure for Mount McKinley from the *north* is the Park road near Wonder Lake. The route is cross-country 18 to 20 miles to McGonagall Pass or the Peters Glacier area. A major danger on this route is the fording of the McKinley River. From the *south*, most ascents involve air-lifting parties to the Kahiltna or other glaciers just outside the Park boundary. The Kahiltna Glacier is the quickest way to the West Buttress which is probably the safest and easiest route on the mountain.

ASCENT ROUTES: Anyone aspiring to climb Mount McKinley should read *The Mountain Worlds*, 1956-57 edition (see reference material). Washburn's article contains excellent material on established and proposed routes, weather, etc. Additional material may often be obtained from the leaders of previous expeditions and from Bradford Washburn, Museum of Science, Science Park, Boston, Massachusetts 02114. However, these people should *not* be troubled unless questions still arise after you have read all available reference material.



PHOTO BY NATIONAL PARK SERVICE

RESCUE: A climbing party high on Mount McKinley *simply cannot count on any sort of assistance* in case of emergency. Even in the best of conditions, it would probably be several days before a gound party could arrive on the scene, and clear-air turbulence can often prevent air support even on sparkling clear days. For all practical purposes, a party high on McKinley is alone, and must depend upon its own resources if emergency situations arise. Injured or ill persons should be moved to lower elevations by the remainder of the group if at all possible. This is for the benefit of the injured person and to aid in rescue by a ground party or possible pickup by aircraft. It is ABSOLUTELY ESSENTIAL that any person requiring air evacuation be removed to BELOW 14,000 feet. Helicopters just do not function safely and dependably above that altitude.

Each rescue involving aircraft will be reviewed specifically in light of the actual conditions which prevail.

Weather must be suitable for visual operations and winds at the site must be within the operating performance of equipment and aircrews. There must also be suitable landing zones to preclude unacceptable risks to both the aircrews and the persons they are attempting to help.

When rescue becomes necessary, the party should request assistance from the National Park Service via the party's radio contact or other means. Each climber should realize that his own group is the best and often only source of rescue aid.

When two or more groups are to be climbing on the same route at the same time, it is recommended that inter-group rescue agreements be considered. The Superintendent will help coordinate this by furnishing necessary information.

PHYSIOLOGICAL EFFECTS OF ALTITUDE: Experiments have shown that effects of high altitudes on McKinley cause severe mental and physical problems. Mental capacity is reduced as much as 50%. Individuals become physically weaker and have virtually no recuperative powers. Their psychological stresses are amplified and lassitude saps the will to perform essential tasks such as melting of snow for water. It is *critical* that climbers on Mt. McKinley and Foraker understand what to expect at high altitudes. Careful study of published material and discussions with experienced individuals should be required of those with no high altitude experience.

FROSTBITE AND HYPOTHERMIA: Cold is as severe on Mount McKinley as is encountered at much higher altitudes in the Himalayas. While individual makeup is a primary factor in resistance to cold and injury, careful attention to clothing is often decisive. Each climber must understand that he may encounter conditions creating an astonishingly severe chill factor. Each should read the article "Frostbite" from the 1962 American Alpine Journal. (See reference material).

CREVASSES: Before unroping, the camp area must be thoroughly checked for possible crevasses. Never set up camp in possible slide areas unless it is impossible to do otherwise. Do not venture outside the camp for any reason without permission from the leader.

PRE-CLIMB ACTIVITIES

Expeditions commonly make the mistake of "rushing" onto the mountain and arrive at a fairly high altitude already physically and psychologically tired from travel and last minute preparations. It is most difficult to "catch up" on rest once on the mountain and adequate sleep is essential for this strenuous climb. Plan an extra day at the staging area so that expedition members will start fresh and well organized. Careful planning and pre-packaging of menus for high-camp use is desirable in order to conserve fuel, reduce meal preparation time and provide a balanced diet yielding 4,000 — 5,000 calories per man-day. It often takes 3 hours to prepare a simple meal at high altitude. Planning will save valuable time. Supplementary vitamins my be desirable for climbs of three weeks or more as menus are often changed while climbing.

FLUID INTAKE: *It is highly important that climbers at high altitude maintain an adequate fluid intake.* A minimum of six to eight pints of water per day is recommended above 16,000 feet. While melting snow is expensive in time and fuel adequate water may greatly reduce respiratory problems and frostbite risk and is essential to general health and performance. Refill your water bottles as often as possible and keep them in your sleeping bag at night.

REFERENCE MATERIALS

"Mount McKinley, History and Evaluation" by Bradford Washburn. *The Mountain World, 1956-57*, Harper Bros., Publishers. New York. $6.00. This is perhaps the best piece of work to date on Mount McKinley and should be required reading for anyone planning a McKinley climb.

Mount McKinley and the Alaska Range In Literature. 1951. Museum of Science, Science Park, Boston, Massachusetts 02114. $2.75 prepaid. A bibliography.

Map of Mount McKinley, Alaska, scale 1:50,000 edited by Bradford Washburn, shaded relief, covers area about 20 square miles centered on the summit of Mount McKinley. Published by Museum of Science.

"Frostbite" by Bradford Washburn, *American Alpine Journal.* 1962 Unillustrated reprints available from Museum of Science, above address. $1.00 per copy. Postpaid.

American Alpine Journal. various issues.

Summit Magazine. various issues.

Treatment and Prevention of Pulmonary Edema by Herbert N. Hultgren, M.D. Reprint from the American Alpine Journal, 1965. Price $1.00 from American Alpine Club, 113 E. 90th Street, New York, New York 10028.

Off Belay Magazine. Various issues.

Accidents In American Mountaineering, 1955, 1961, 1962, 1963, 1964, 1967, 1968, and 1970. Booklet by the American Alpine Club. Above address. (1962 and 1963 editions are out of print.)

Map of Mount McKinley National Park, plain contour or shaded relief, scale 1:250,000. $9.75 each. Also topographic maps in 15 quadrangles, scale 1:63,360, covering this and adjacent areas. $0.50 each.

Determine your needs from the "Index to Topographic Maps of Alaska" which can be obtained from: U.S. Geological Survey, Distribution Section, Federal Center, Denver, Colorado 80225. Alaska residents may order limited quantities of Alaska maps from the U.S. Geological Survey, Distribution Section, 310 Fairbanks Avenue, Fairbanks, Alaska 99701.

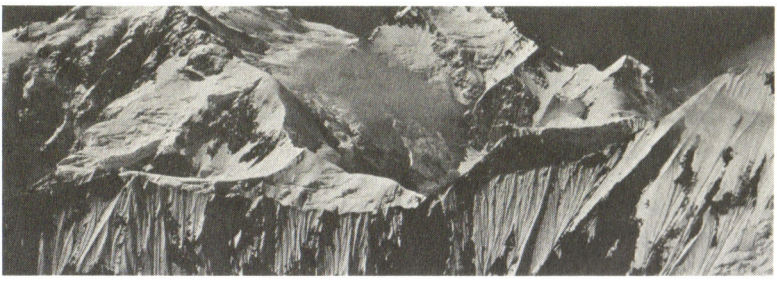


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SUMMARY

The following steps are necessary to participate in mountaineering expeditions in Mount McKinley National Park.

1. Obtain all the information you can on the scope of your proposed climb. The Superintendent and his staff will be glad to help.

2. At least 60 days prior to the expedition, submit to the Superintendent:

   a. Individual applications — send as early as possible

   b. Physician's certificates

   c. Radio information (type to be used, frequency, relay, etc.)

3. To avoid confusion, it is imperative that one man handle all correspondence with the National Park Service, air service, and other organizations. The expedition leader must be named and the name of the party must be given on all correspondence.

SEND ALL INQUIRES, APPLICATIONS,

AND CORRESPONDENCE TO:

Superintendent
Mount McKinley National Park
P.O. Box 9
McKinley Park, Alaska 99755

CLIMBING PROBLEMS

Prepared by Institute of Arctic Biology University of Alaska (reprinted by permission as written).

Mt. McKinley, the highest mountain in North America, offers mountain climbers some of the most severe conditions found anywhere on earth. As Terris Moore points out in his book "Mt. McKinley: The Pioneer Climbs" when the Quartermaster Corps was searching for a place on the North American Continent where temperatures of at least -20 to -25 degrees F. could be found, dependably, during the summertime, it chose the high basin between the North and South Peaks of Mt. McKinley. Cold, lack of oxygen, and windstorm here provided conditions found only thousands of feet higher in other parts of the world. The combination of these factors with long exposure create severe hardships and pose unique problems for climbers on Mt. McKinley that are not encountered elsewhere in this country. In most cases climbers return from McKinley physically weaker than when they left. While trips to lower mountains may help build a climber's strength, a McKinley expedition may drain his strength and lead to deterioration of body functions.

This information presents problems, inherent in Mt. McKinley climbs, which affect the physiology of the climbers. It also presents a brief introduction to the research program being carried on at the University of Alaska to investigate these problems.

PHYSIOLOGICAL AND PHYSICAL IMPAIRMENT

These responses to a prolonged and severely hostile environment constitute an interaction within the area of human ecology which is the subject of a continuing research program at the Institute of Arctic Biology of the University of Alaska. Every mountaineer preparing to climb Mt. McKinley is aware that at high altitude he will be physically weaker. He will move more slowly and not be able to carry heavy loads. There are also other results of activity at high altitude less commonly known but potentially as dangerous, such as mental impairment, dehydration, lassitude, loss of cold resistance, and lack of recuperative powers. A major environmental variable responsible for some of these effects

is the lack of oxygen (hypoxia) associated with high altitudes. Terris Moore has recently pointed out (Proc XVII Alaskan Science Conference, in Press) that because of its greater distance from the equator, an altitude on Mt. McKinley may be physiologically equivalent to a 2,000 feet higher altitude in the Himalayas. Physiological responses to these environmental stresses are under investigation at the Institute of Arctic Biology, and it is hoped that such studies will contribute to the success and safety of future high altitude mountaineering expeditions.

Mental Function:

Bradford Washburn has estimated that above 18,000 feet on Mt. McKinley a person is reduced to roughly 50% of his mental capacity. In the winter assault of 1967 three McKinley climbers required approximately twice as much time to answer a series of subtraction problems after remaining at 18,000 feet for six days as they did at 7,000 feet on the Kahiltna Glacier. In retrospect most high altitude climbers can recall situations in which their thinking was impaired and their judgement poor. These effects are insidious, the disability being commonly inapparent at the time. A controlled exposure in a low pressure chamber is often necessary to convince a climber (or flier) that hypoxia affects him. Many high altitude climbing accidents may be attributed to such lack of judgement. Thus, it is important that climbers realize in advance that their mental functions will be impaired. Planning should be thorough and complete to avoid a critical situation which poor judgement and slow thinking would magnify. For example, sudden impulsive decisions to go on or to return must be considered carefully.

Simple tests can be given to detect changes in mental function through effects on memory, time estimation, and calculation ability. Changes in other brain functions can be estimated by tests of balance and coordination. These tests, first administered in an altitude chamber prior to the climb, may give some indication of how a reduction in oxygen supply will reduce a climber's efficiency when he is high on the mountain.

Lassitude:

At high altitude motivation can diminish greatly. Thus, Joseph Wilcox, leader of a 1967 McKinley party wrote in his diary "With five people crammed in the tent morale decreased rapidly. There was no interest in cooking meals and by the next day no one was even interested in melting drinking water. We found ourselves very apathetic — not caring whether or not we got enough to drink or eat or if our gear was wet — we just lay there and waited with little or no sleep . . . By morning the cold had taken its toll — Jerry Lewis and I had numb feet and I had numb fingers." Here the motivation to do even the simplest camp chores almost disappeared; yet these tasks — melting snow for water, cooking a hot meal, drying clothes in the wind — will help determine the success and safety of a party. The will to survive and succeed must not be sacrificed to lassitude.

Inactivity during tent-bound stormy days can itself be devastating to morale, and as tiring and debilitating as climbing. Washburn stresses how some systematic activity during stormy days such as a short walk, weather permitting, or building a latrine with snow blocks can help to keep the body limber and the mind alert. Physiological testing can be used to alleviate boredom on days of enforced inactivity.

Leadership and Interpersonal Relationships:

Irritability can easily spring up between even close friends during a stay at high altitude. A nagging fear, doubt, or feeling of guilt can easily grow in a person's mind and prove mentally exhausting as well as potentially dangerous.

Leadership characteristics may undergo drastic change because of the stressful situation. Drastic personality change may bring out latent domineering tendencies in anyone which can be extremely upsetting to group relationships. Being on the mountain may precipitate a variety of phobias, including claustrophobia from living in close quarters, which can lead to panic with an overwhelming desire to run away. In extreme cases a single climber may even leave the group and attempt to ascend or descend by himself, which can lead to fatal consequences.

By testing mountaineers before a climb it may be possible to detect areas of phobic preoccupation and glean personality traits which cause harmful reaction tendencies to assert themselves. A maximal understanding of these problems is essential for the smooth leadership and interpersonal relationships necessary for a successful stay on the mountain.

Work Capacity:

The capacity to carry out strenuous physical work at high altitude is an essential factor in the successful climb of any mountain. Work is limited by the ability to extract oxygen from the thin mountain air and to deliver it to the brain, muscles, and other tissues. In the 1967 winter climb, for example, it was notable that the three climbers who reached the summit were those judged most physically fit at the start on the basis of standard exercise tests.

Simple step tests done in and out of an altitude chamber can give some indication of how a climber's work capacity changes with altitude and may make possible more efficient planning of the work schedule on the mountain. Tests which are done in the laboratory prior to the climb may be repeated on the mountain if a proposed high altitude laboratory is established there. This would give greater insight into what happens to a climber physically when he is on the mountain.

Acclimatization to Altitude:

S. M. Tenney emphasizes the importance of acclimatization in climbs over 15,000 feet. The McKinley Park regulation requiring climbers to begin at the Park Boundary and prohibiting air drops inside the Park may appear hampering to an eager mountaineer. In actuality this regulation has undoubtedly contributed to the success of many expeditions, because of this necessity for the climber to gradually acclimatize to the thinner air. Carrying loads at gradually increasing altitudes is accepted as the best way to acclimatize. Some McKinley expeditions have found it very helpful not to "push" when they move above 14,000 feet but allow themselves a day or two at each high camp to adjust before moving higher.

Dehydration:

Dehydration is a major hazard of high altitude mountaineering. Dehydration compounds the problems of any illness or injury, making recovery more difficult. The chances of frostbite are believed to be much greater when a climber's body is dehydrated.

Climbers rarely drink an adequate amount of liquid above 14,000 feet. Fuel for melting snow is not difficult to carry, yet the tendency is to take only a minimum rather than an adequate amount. A party should always carry an extra

week's reserve of fuel when high on McKinley. It is inviting tragedy not to have at least seven day's supply of fuel if one plans to spend even one night above 17,000 feet on Mt. McKinley. This fuel must be used to provide each climber with at least three quarts of liquid each day.

The principal mechanism of dehydration is evaporation through breathing. Moist warm air is exhaled while very dry cold air — with the average humidity of a desert — is inhaled. The very large ventilation volumes needed to supply the oxygen necessary to carry heavy loads up steep inclines in the thin mountain air increases the loss to many times that under ordinary circumstances.

Water is also lost to clothing through sweating. Temperatures which can range from 60 above to 40 below zero Fahrenheit are conducive to sweating and chill when combined with the work performed and the severe winds encountered on the mountain.

Dehydration causes a reduction in blood volume and an increase in blood viscosity. Further, it upsets the body electrolyte balance which disturbs the acid-base balance of the blood. These changes affect both the muscles and the mental functions of a climber.

Illness or Injury:

It is virtually impossible for the body to recover from many illnesses and injuries above 14,000 feet. Hypoxia and dehydration seriously impair the body's recuperative powers. A sick person should if possible be taken immediately below 14,000 feet where he will have a better chance of recovery.

Altitude nausea and dizziness will often disappear if a climber goes to a lower altitude. Even after one night below 14,000 feet the climber may feel fit and subsequently be able to climb to 20,320 feet.

Diarrhea can be fatal when climbing above 14,000 feet. Dehydration is further aggravated and with impaired absorption the body receives little nourishment and is further weakened. A person suffering from diarrhea above 14,000 feet should be taken below 14,000 feet while he can still make the trip down. He should not go up again until his gastro-intestinal function returns to normal.

A person with wheezing, gasping, and coughing, suggestive of pulmonary edema, should be immediately taken to as low an altitude as possible. Some relief from pulmonary edema can be obtained on the mountain if the climbers are able to use proper medical treatment and have had instruction from a physician on this matter. Cardiac and pulmonary dysfunction are grave dangers on the mountain, and their debilitating effects increase exponentially. Therefore, action must be taken immediately. Waiting under hypoxic conditions can be fatal. Death can come only hours after the first symptoms appear. The best therapy is to transport the climber to below 10,000 feet as quickly as possible.

Cold Resistance:

One of the major hazards of a McKinley climb is frostbite. Mt. McKinley presents a combination of long exposure, severe weather, high altitude, low temperature and low humidity which makes it one of the most severe climates on earth. Mountaineering literature contains numerous vivid accounts of frostbite on Mt. McKinley such as Bradford Washburn's excellent article which can be obtained from the American Alpine Club. With proper protection, however, this complication need never occur. Adequate clothing, food and water are essential at all times. Three 1967 winter McKinley climbers had their feet frostbitten while they were in their sleeping bags primarily because they had little to eat and were dehydrated. Subsequently two of these climbers lost portions of their toes. It should be pointed out, however, that they were living at 18,000 feet for six days with temperatures of -50 and -60 degrees Fahrenheit and winds of 90 — 100 mph. If they had not kept calm and retained a degree of awareness of the major problems, or had let panic or unreasonable fear overwhelm them, they might have fared far worse. It is believed that cold resistance may be impaired by altered nervous or metabolic regulatory control.

A measure of cold resistance is gained in the laboratory by analyzing functional efficiency as it changes in the presence of cold exposure. Such things as rapid, successive finger movements, sensitivity of fingers, alteration of peripheral nerve conduction, and ability to perform useful work can be measured. These measurements can give one some idea of ability to be expected under certain conditions of cold.

It should be unnecessary to reiterate the probable deleterious effects of smoking tobacco on a high altitude climber. Not only may physical endurance be decreased but peripheral circulation is likely restricted so that cold injury is more likely to occur.

Fatigue:

Another aspect worthy of note is that virtually all of the difficulties outlined above may be preceeded or compounded by over fatigue — usually by one member of the party before the others. When such indications are first observed the party should stop, rest and recuperate.

To a considerable extent, Mt. McKinley represents a problem in logistics and weather so that climbers often feel that they must make the best use of good climbing conditions even though it may over extend the physical and emotional capabilities of some or all of the party. If violent weather overtakes them in this condition, tragedy can follow. Climbers must maintain a physiological margin of safety against fatigue and cold just as they do for food and fuel. In this connection it has been suggested that the extra effort of preparing igloos or snow caves for shelter at high altitude rather than putting up tents, is well worth while in terms of the greater protection and rest afforded.

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A. Davidson, V. Hoeman and H. Marshall (mountaineers); P.R. Morrison, J. Nava, J.H. Petajan and G. Schumacher (physiologists, scientists). We are indebted to T. Moore, S.M. Tenney and B. Washburn for helpful review and suggestions.



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