

SNOW AND AVALANCHE TRAINING FOR THE ARMED SERVICES

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ABSTRACT

Military history bears out the seriousness of snow hazards in all campaigns in snowy mountain terrains. European armies of WW I and II benefitted greatly through employment of highly trained mountain divisions. With only one such division in 1945, the U.S. Army was rewarded by the excellent record of the Tenth Mountain Division in Italy, and yet, collectively, the opposing 18 German mountain divisions would have been an overwhelming force if such a confrontation had developed.

A modest mountain training program today enhances the mountain abilities of all branches of the U.S. armed forces. Curricula for such training takes its lead from both civilian and military literature and experience, but certain elements of risk, tactics, and terrain analysis apply uniquely to military mountain situations.

INTRODUCTION

The history of warfare and deployment of peace time armies in high latitudes is marked by catastrophes related to natural or man-induced snow hazards. Of these, snow avalanches represent the most serious threat to tactical operations. This is not to deny that problems involved with troop movements over snow, in general, demand very special consideration. The possibility for expansion of warfare into snowy and alpine terrain demands readiness for such situations where ground troops hold the tactical edge over other forms of defense. Modern military doctrine still dictates that mountain ridges and other high places are "key terrain for observational fields of fire and thus the control of adjacent valleys". For operations in areas of snow-covered terrain, education on the behavior of snow is critical to safety and survival in such situations. In addition, snow will continue to be considered a tactical weapon in military operations. The purpose of this paper is to present a background of military history involving snow and avalanches, and to describe and suggest modern training activities involving snow, particularly those that are uniquely military in nature.

DIFFICULTIES ENCOUNTERED IN PAST MILITARY OPERATIONS

Bits of information gathered from a number of publications (Casewit 1972, Atwater, 1968, Armstrong and Williams, 1987) attest to the struggles

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that some ancient armies had in operating under hazardous snow conditions. The most detailed reviews of these operations lie in the archives of European libraries and are not easily available in America. Parenthetically, in the complete military mountain warfare bibliography of the U.S. Army Military History Institute at Carlisle Barracks, Pennsylvania, not a single title refers to snow avalanches, although some principles of avalanches are included within the context and subtitles of several manuals. Many references in this bibliography are likewise concerned with a whole gamut of operations in arctic and snowy terrain. The bibliography is available and should be requested for training references that are applicable to any training mission where the focus is on snow.

Hannibal, in crossing the snow-covered Great St. Bernard Pass during the Second Punic War in the Third Century, B.C. encountered the first recorded military avalanche problem (Armstrong and Williams, 1987). Fraser (1978) describes the army of Alexander the Great crossing into Persia and losing large numbers of troops through avalanches. In Europe, many armies during the 14th Century and the Napoleonic wars suffered thousands of fatalities as a result of snow avalanches. According to Col. Arthur Zechner, Chief of Training for the Austrian Army (1990, pers. comm), 60,000 troops died from avalanches alone in the Austro-Italian Campaign of WW I during three winters in the Dolomite Mountains. The casualties were caused both by natural avalanche releases, and by artificial releases set off by foot soldiers in tactical operations. Apparently, not all troops were well trained in mountain warfare and some did not take necessary precautions against avalanches. In the words of the famous ski pioneer and Austrian General, Mathias Zdarski, "the mountains in winter were more dangerous than the Italians". One report indicated that 3000 Austrians were killed in one 48 hour period by the Italians, who blew up a summit ridge snow cornice precipitating a great avalanche wave that descended onto the Austrian positions. If one fourth of an army can be eliminated in three winters of snow avalanches, the whole aspect of snow and avalanches is still important in the planning, training, and tactics for any operations in snowy mountainous terrain. Space does not permit a detailed account of the fantastic feats of the Austrian-Italian mountain troops in WW I, but suffice it to say that they were the key units in the overall organizations of both armies. The same could be said for the German mountain divisions of WW II.

MOUNTAIN AND WINTER TRAINING OF U.S. TROOPS DURING WORLD WAR II

In the early 1940's, some planning took shape on the problem of U.S. military operations in high latitude mountainous terrain. The Army gathered several small units of company or smaller size, and issued what little special equipment for such maneuvers then existed. Leadership for such units were selected from among leading skiers, rangers, and mountaineers, and training took place at three different sites in the United States. One notable unit, under the command of Lt. John Woodward, demonstrated that even with only moderate training, platoon size units could traverse the base of Mt. Rainier, crossing all the hazardous glaciers, avalanches, and steep snowy slopes for two weeks with relative ease and speed (Burton, 1971). However, it was not an easy proposition for Minot Dole and his friends, of the U.S. National Ski Patrol, to convince the Army that a regiment of specialized mountain troops, to say nothing of an entire division or divisions, were needed at a time when the Germans had 18 such divisions employed (Harper, 1943). Dole persevered,

and the 87th Infantry, Mountain Battalion, was formed at Ft. Lewis in late 1941. Shortly thereafter, the Tenth Mountain Division was organized at Camp Hale, near Leadville in the Colorado Rockies.

During Camp Hale training of 1942-44, when the U.S. Tenth Mountain Division was being brought to full complement, David Brower and his group prepared an excellent "Manual for Mountain Troops" (Brower, et al, 1942, 1946), which covered state-of-the-art information on snow and snow hazards, and other mountain environmental conditions. According to Brower (1989, pers. comm.), much of the input for this manual came from the pioneer observations of Gerald Seligman (1936) on the technical aspects of snow as a support medium and producer of avalanches. The manual was used by the troops, but only a select few received the intense practical training suggested in the manual. The complex of other problems at that time more or less diluted intensive training in snow hazards for this brand new mountain division. The need for acclimatization and intensive snow training was dramatically demonstrated on one occasion during winter maneuvers near Leadville, Colorado, when troops in numbers succumbed to frostbite, exhaustion, and general lack of confidence, and were evacuated to basecamp. (Burton, 1971). Needless to say, early maneuvers failed because of such inadequacies, bringing severe reprimands by the general staff and renewed intensity in preparatory training. This was a particularly critical event in the history of this Division since such special training was never popular among some key staff members in Washington, and the whole issue of ultimate assignment and designation of the Division was seriously threatened. According to Burton, (1971) when later asked, Chief of Staff, General George Marshall remained a staunch supporter of mountain and winter training and claimed that if a mountain division such as the Tenth had been available to operate in the snowy Apennines near Cassino during the winter of 1943, the entire German communication system in Italy could have been knocked out,-- so, of course he supported the Division and its training mission. The support for thorough and lengthy training for such special troops, and the "time hardening" to brutal winter conditions was thus assured for WW II, at least.

Not all personnel of the early Tenth Mountain Division were initially skilled and acquainted with mountains. In fact, some units were sent to join the Tenth from tropical flatlands, and many of them did not appreciate the rigorous mountain environment of Camp Hale. As training proceeded flatlanders became swept up in the high spirit and interest of the alpine experience. When the division was moved to Camp Swift, Texas, most of the originally uninitiated were the first to complain about leaving the mountain environment of Colorado and readily identified themselves as mountain troopers. Such experience seems to confirm the common perception that an association with mountains is a rallying point for high morale and spirit. Certainly the European mountain troops of WW I and II bear this out (Lucas, ca 1980).

Mountain troopers tramped the uplands of Colorado on stiff maple skis in three feet of bottomless snow, encountering buried rocks during early maneuvers of the winters of 1942-1944. Looking back on this situation, it is obvious this condition resulted from massive "depth hoar", which, of course, is well known today for its weakness in a shear stress field. This snow condition flourished in the high altitudes, cold temperatures, and relatively thin early snowpacks of the Leadville area. Had those maneuvers demanded negotiating steeper terrain at that time, snow avalanches would have taken

their toll. However, only two serious avalanches were recorded during this field training, - one was a deliberate artillery release on the northeast flank of Homestake Peak, - the other a similarly released slide on the south face of Chicago Ridge, near Tennessee Pass. Winston Pote (1982) photographed both slides. Prior to the former slide, soldiers ordered to recover parachuted equipment on the slope were saved from possible involvement by the timely warning of an experienced mountaineer, Major Walter Wood, who was serving as an observer (Burton, 1971).

The wonder is that no serious avalanche accidents were experienced by the Tenth Mountain Division or its detachments during WW II, but this was a fortuitous circumstance that might have been entirely different had the timing of military operations allowed Hitler to defend his last "redoubt" in the Alps. If the Tenth Division had not been relieved by the cessation of the Italian Campaign in the summer of 1945, and had faced a situation that involved winter warfare in the true Alps these troops would probably have been exposed to some very severe snow hazards. On the opposite side of the line, with extensive training and lifetime experience in alpine environments, one or more of the eighteen Austrian and German mountain divisions were probably better prepared to withstand the winter condition than the Tenth Mountain Division. The point has been made (Harper, 1943) that to expect a single alpine trained division to stand up to an opponent with division after such division at his disposal is courting disaster. Directly following the European armistice, plans were evidently being made to transfer the Tenth to the Japanese Theatre for a campaign in the mountainous and snowy Sakhalin Islands, another winter challenge for this special unit.

Today, after 50 years of research on snow, ice and avalanches by such groups as the U.S. Army Cold Regions Research and Engineering Laboratory, the U.S. Forest Service, National Ski Patrol, and other volunteer groups, we should be more prepared for winter warfare than we were in 1946. But only a few experts on snow are now within the ranks of the Army and spot-centered training activities for a few units is being carried on. The Army could be doing more in terms of numbers of troops trained. If twenty percent of the Earth's land area is mountainous and/or underlain by permanently frozen ground or "permafrost", should not a corresponding twenty percent of our armed forces be educated, trained and ready to operate in these terrains? In spite of the present demilitarization of Europe, in one way or another we will see a demand for troops that are acclimatized to snowy mountainous terrain. Even peacekeeping duties under the current state of geopolitics require policing mountain lands as well as other geographical locales. While the strategists of our top military command continue to debate the question whether special training for mountain operations will be carried on, the following discussion may contribute valuable insight on how we could proceed with state of the art training.

PRESENT STATE OF U.S. ARMY TRAINING AND PREPAREDNESS

Although it is not generally publicized in the every day military news, some fairly comprehensive mountain military training programs are currently under way involving all branches of the service. The programs are somewhat uncoordinated as among the various branches, but yearly conferences involving the leadership of these programs are beginning to lead to some standardization in both the nature and concepts of training and the testing and purchase of

special mountain equipment.

Considering the experiences described above, we applaud the reactivation of the Tenth Mountain Division at Ft. Drum, N.Y., the on-going army "Mountain Warfare School" at Ethan Allen Firing Range in Jericho, Vermont, special training at Ft Richardson and Ft. Greeley, Alaska, and the continued scientific research of such army-sponsored establishments as the Cold Regions Research and Engineering Laboratory at Hanover, N.H.

The Marine Corps, likewise, has an excellent program in the Sierras and seeks to train all Marines in at least the basics of winter mountain operations. It would seem that principles of snow avalanches should be included in this training. The U.S. Tenth Special Forces has recently gained intensive alpine experience under the training program of the German Gebirgstruppe in Bavaria. Special 6 week army training programs in ski, snowshoe, and glacier travel at Ft. Greeley, Alaska are encouraging and include some avalanche training and rescue. Although limited to relatively few personnel, the U.S. Navy "Seal Program" features several weeks of mountain snow training in Utah and Fort Richardson, Alaska. The Air Force has a program in arctic and high altitude rescue in Alaska.

Among NATO forces, the most outstanding military mountain training is carried on by the Austrian Army. The program is centered around the civilian Alpine Guide organization. It involves basic mountain training for 15,000 soldiers each year, and as much as three years qualifying training for 400 elite officers who ultimately must achieve the top Military Alpine Guide rating of "Bergfuhrer". The latter training involves a deliberate methodical step by step process, and, of course, includes extensive coverage of snow and avalanche intelligence, rescue, terrain assessment, risk analysis and other related subjects.

Since 75% of Austrian land is mountainous, a large part of the population have naturally acquired mountain skills which are easily integrated with army service. Testing of equipment proceeds systematically, and standardization of such equipment is important. It is estimated that three fourths of the potential mountain operation accidents are thwarted by good training and long experience. Incidentally, in mountainous snow terrain, all foot soldiers must wear a rescue beacon.

Serving U.S. military mountain activities, several manuals have succeeded the original literature of 1943 on the subject of snow and avalanche training. One nearly up-to-date manual reviewed is entitled "Military Mountaineering: TC 909-6-1", -- a Training Circular printed by the Army. It is an excellent work and useful even today as a basic snow text for troop training and management. Nothing is mentioned, however, about the tactical use of avalanches in a battle situation or the capabilities of snow as a bearing surface for vehicles.

U.S. Army Training films are available, such as TF 7-1550, "Combat in Deep Snow and Extreme Cold", TF 21-3478, "Avalanche Hazard", and some "survival" types of manuals are in print. These are probably applicable to present training. Malcolm Mellor of the U.S. Army Cold Regions Research Laboratory, wrote an excellent manual on snow and avalanches (Mellor, 1968), which should be useful for a number of training missions on these subjects.

An authentic and intensive training program in mountain and winter warfare developed under the direction of Lt. Col. Russ Holden is conducted at Ethan Allen Firing Range, Jericho, Vermont, on the west flank of Mt. Mansfield. The 3rd Battalion of the Vermont National Guard 172nd Inf. Regt. and other detachments continue to receive training there.

SOME ASPECTS OF SNOW AND AVALANCHES THAT SHOULD BE PART OF AN ARMY TRAINING PROGRAM

Since the close of World War II, scientists, recreationists, and others with a stake in snow and mountain activity have struggled to master "the snow game". The Americans have been competitive with the rest of the World in this activity. The headlong push of civilization into the snowy areas, sparked by the need for more living room, and for extraction of raw materials, but in large part by the development of new and more exciting ski and other recreational terrain, have demanded much more proficiency in handling snow and snow hazards. Progress has been slow but continuous. As is well known to those active in snow research, most investigators believe that the conditions that precipitate major snow avalanching can be anticipated by examining snow on the spot and by knowing the history of local meteorological events. Most of the "big ones" can be predicted within a degree, but surprises continue to occur leading some to say that avalanche control and forecasting is still an art. Still, special snow training among the troop leaders of today should allow for significant safety in guiding troop occupation and movement in snowy alpine terrain.

In snow and avalanche education in general, we are most familiar with the excellent work of ski patrols, avalanche institutes, and U.S. Forest Service professionals and volunteers, in developing the procedures for avalanche safety. This resource could be explored in planning for any future tactical situation in which the threat of avalanches, or even of other difficulties in negotiating snowy terrain, come into the picture. If the Army cannot afford to train an entire Corps in the principles of snow safety, it might involve a civilian arm that would stand ready to fill whatever gap is necessary in a time of national emergency. At the same time, the Army, Marines, Air Force and special military groups are making use of new developments in snow science so that this information can be passed on immediately to training officers for schools such as the one at Jericho, Vermont. At the very least, career officers and non-commissioned officers who would be expected to operate under alpine or snowy conditions should be thoroughly trained in snow science, including hazards. Maybe modern units will not be placed in a position to set off "the white death" like the Italian Alpini and the Austrian Gebirgsjaeger of WW I but it should be possible for such units to make an approach march, or to travel through snowy terrain without disastrous consequences.

Gaining knowledge of the scientific principles of snow necessary to operate successfully in high latitude terrains need not discourage those without advanced scientific and mathematical backgrounds. At the same time, snow avalanche phenomena cannot be mastered without a certain amount of intense study, and, above all, field experience, over a period of weeks and months. Teaching such courses is a difficult assignment. Although direct

training of regular army units would be the most ideal way to proceed, if this seems impractical one of many other ideas involves using northern college-based ROTC programs. Teachers could be prepared to instruct principles of snow dynamics, together with the necessary field work in the mountain areas, to ROTC units or, by special assignment, the regular Army. Dartmouth, Middlebury, Vermont, St. Lawrence, and the Michigan, Minnesota, Montana, Idaho, Wyoming, Oregon, California, Washington, and Alaskan universities all come to mind as potential resources. Even troops assigned to flatland states such as North Dakota, Wisconsin, or Minnesota would need training in snow science and behavior. Many institutions do have ROTC training and some have non-ROTC courses in snow sciences that could be exploited if necessary. In addition, the National Avalanche School conducted annually by the National Ski Patrol have by now put thousands of civilians through this routine, - providing an important and continuously upgraded nucleus that could be utilized in a national emergency.

SUGGESTED CURRICULUM FOR MILITARY SNOW PROGRAMS

Several references are made above to resources for teaching the practical and scientific aspects of snow. Some of these publications were written as early as 1942 or before. New material is constantly being compiled on the subject. A problem may exist in obtaining information, but more pressing is the need to include snow science in the basic training and general education of a critical number of personnel who could be expected to operate in subalpine or alpine terrain in high latitudes.

The field area for snow and avalanche training should be carefully selected. While maritime alpine areas contain important lessons in negotiation of deep, wet snows, higher altitude interior alpine conditions should likewise be part of the experience. Certainly training should involve elevations above 7,000 feet. Some mountainous areas in New England, such as the White Mountains of New Hampshire, the Green Mountains, and the Adirondacks probably include parcels of this type of terrain. The Rocky Mountains from Colorado to Montana certainly do, and likewise the Sierra-Cascade province, and Alaska. From recent on-site experience, Robert Frauson, (1990, pers. comm.), suggests that special reservations adjacent to the newly established Tenth Mountain Division Trail. near Camp Hale and Aspen, Colorado would fulfill the authentic training requirements in a most excellent way. Environmental sensitivities must also be dealt with in any such operations today.

Snow and Avalanche Training

Successful courses in the principles of snow science, and avalanche prediction and control, taught for the general public, include general data on snow and snow avalanches that can be used by the military. Existing literature for such curricula contain general to specialized subjects that serve well as outlines, and can be found in such publications as the "USFS Avalanche Handbook" (Perla and Martinelli, 1975), "Avalanche Safety for Skiers and Climbers", (Daffern, 1983), and the "National Ski Patrol Avalanche Instructor's Handbook". Additionally, the Education Committee of the American Association of Avalanche Professionals has recently (1990) compiled "Guidelines for Avalanche Course Curricula" which contains a useful

compilation of subject matter and course listings. We shall not repeat this information here, but it does seem appropriate to point out several aspects of snow and avalanche training that are unique to the military and not necessarily related to civilian mountain training.

We believe the U.S. Army should approach the requirement for training mountain troops through two levels of activity. Its most complete and intensively trained individuals could be limited to "elite" units whose duties involve serving as experts, advanced troops, small mobile squads, and key individuals attached to Regiment, Brigade, or Division size groups. The second general category would include the entire complement of units as large as a Brigade who receive basic training in the elements of snow operations if it is remotely possible for assignment in mountainous and snowy terrain. The latter program is an abbreviated core version of the more intense curriculum.

In all such training, a central point of interest would serve as a stimulus to learning and practice. The "mountain spirit" is an identification and source of pride that serves as a most important rallying point.

Snow and Avalanche Problems Unique to Military Situations

In addition to well established civilian avalanche course principles, certain aspects of snow and avalanche activity are uniquely identified with military situations. The following discussion summarizes some of these considerations:

1. Management of tactical risks:

-It is sometimes necessary to accept military avalanche risk to gain a tactical objective, but still the risk may be mitigated by route selection, timing, prior forecasting, and camouflage. A policy of accepting conscious risk, if successful, can lead to a vicious circle that repetitiously includes exposure to unconscious risk and therefore to ultimate serious accident (see Fig. 1., from Col. A. Zechner, Austrian Army, personal communication, 1990)

Fig. 1.

RISK IN SNOW HAZARDS

Conscious Risk

(may lead to)

Success

(if repeated, may lead to) --**Unconscious Risk and Ultimate Accident**

- The problem of leaving tracks in the snow.
- The problem of search and rescue under tactical conditions; delay and night search may be demanded.
- Computerized forecasts based on terrain maps are useful for planning troop movement through hazardous terrain.
- Could the military use group dynamics in hazard decision making? What would be the effect on military "chain of command" if lower ranks are asked for their opinion of alternate routes in a high risk approach?
- Terrain analysis from a tactical viewpoint; the integration of tactics with snow and avalanche situations when taking commanding heights.

2. Offensive snow and avalanche tactics:

- Avalanche triggers; natural, artificial; a tactical "two way street."
- Use of low and high profile military weapons for release of avalanches.
- Snow as an obstacle or aid to troop movement; shared by opponent.

3. Passive defenses for avalanche hazard; vulnerability to sabotage.

4. Avalanche zoning for military situations using map relations, Landsat images, and established weather patterns.

CONCLUSION

Successful operation in high latitude military mountain situations demands excellent basic training in snow and avalanche principles, and extensive field experience in snow and avalanche terrain.

ACKNOWLEDGMENTS:

The authors appreciate the help of all who have contributed to this project through discussions, references, and field meetings. In particular we acknowledge; Faye Johnson, Maj. Larry Stomprud, Msgt Laverne Allar, Phillip Stevens, David Brower, Newcomb Eldridge, Robert Frauson, S.G. Custer, Donald Bachman, and the entire staff of the ARNG Mountain Warfare School, Ethan Allen Firing Range, Vermont. The use of Montana State University facilities and library services were of great help in completing this project.

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